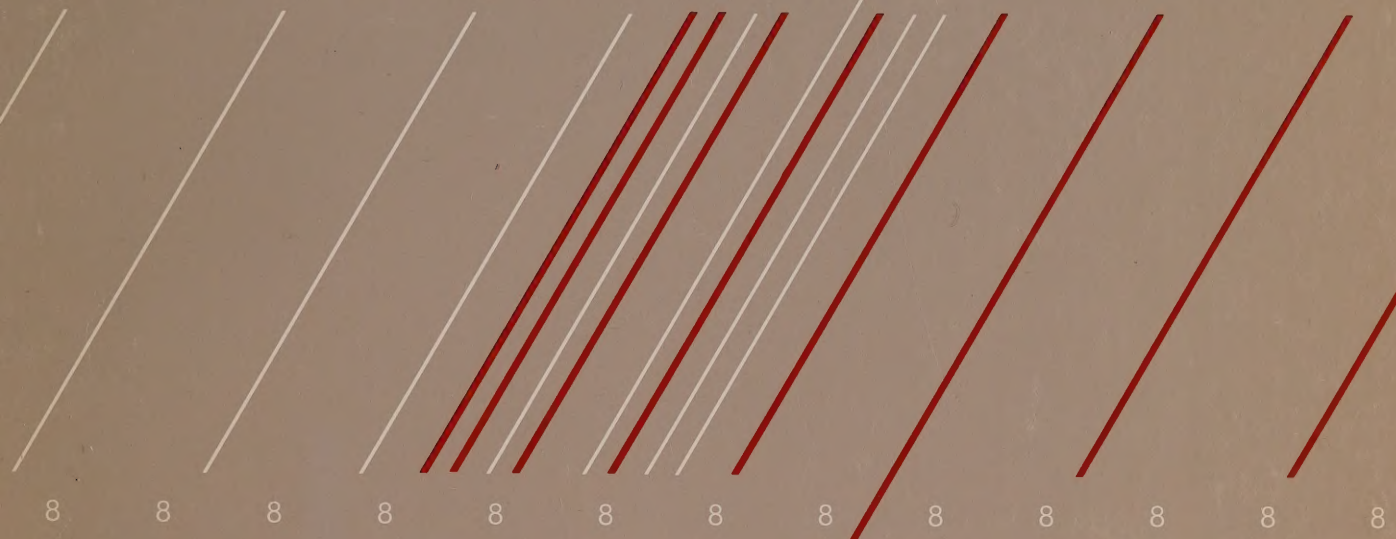
The Ontario
Task Force on
Employment and
New Technology



Employment and New Technology in the Aircraft and Aircraft Parts Industry

An Appendix to the Final Report

ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

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APPENDIX 8

EMPLOYMENT AND NEW TECHNOLOGY

IN THE AIRCRAFT AND AIRCRAFT PARTS INDUSTRY

This Appendix contains a report prepared for the Ontario Task Force on Employment and New Technology. The topic was approved in advance by the Task Force. At the conclusion of the study, the Task Force had the opportunity to review the report but its release does not necessarily imply endorsement of the results by the Task Force or its individual members.

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FOREWORD

The Ontario Task Force on Employment and New Technology, a joint labour-management group, was established in May 1984 "to consider and report on the manpower and employment implications of new technologies as the same may be introduced and applied in Ontario during the next decade and the extent and nature thereof."

To inform its discussions, the Task Force established a research agenda designed to gather information on employment and technological change from a wide variety of sources. The research agenda contained projects which gathered information of a historical nature, and projects with a future orientation which were designed to gather information describing likely occupational and employment implications associated with technological change in the 1985-1995 period.

The Appendices to the Final Report of the Ontario Task Force on Employment and New Technology contain reports of these research projects. A complete list of these Appendices may be found at the rear of this document.

Among the Appendices are reports of a series of studies to assess the extent and nature of the employment implications of new technology in selected industries in Ontario. Appendix 3 describes the process by which the industries were selected, and contains the studies' terms of reference which called for particular attention to selected new technologies and occupational groups. Appendices 4-18 contain reports of these industry studies, which were conducted by Currie, Coopers & Lybrand, management consultants.

This particular appendix contains a report of the study on the Aircraft and Aircraft Parts Industry.

Dr. Richard L. E. Brown, P.Eng.
Research Director

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The Board of Industrial Leadership and Development (BILD) of the Government of Ontario.

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The Ontario Ministry of Labour.

The Task Force would like to thank the staff of Currie, Coopers & Lybrand, particularly Maureen Farrow and Victor Rocine, whose assistance in the conduct of this study was greatly appreciated.

Special thanks are due to all industry experts and survey respondents who provided information for this study.

EMPLOYMENT AND NEW TECHNOLOGY IN THE AIRCRAFT AND AIRCRAFT PARTS INDUSTRY

A Report Prepared by Currie, Coopers & Lybrand
for the Consideration of the Ontario Task Force
on Employment and New Technology

July, 1985

Submitted By: Maureen Farrow
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PART I - INTRODUCTION AND METHODOLOGY

1.0 INTRODUCTION

This report is one of a series of industry reports which summarize the findings of a major research project[1] undertaken for the Ontario Task Force on Employment and New Technology. Each report includes a historical analysis and an outlook to 1995 for the industry, and a review of the anticipated impacts of new technology on employment.

1.1 Structure of This Report

This report presents the study findings for Ontario's Aircraft and Aircraft Parts Industry (SIC 321)[2]. The report includes four parts.

- The first part (Chapter 1.0) is the Introduction which includes a description of the approach and methodology.

- The second part (Chapter 2.0) is a Historical Analysis for the industry from 1971 to 1984 which provides background and a perspective on the industry's historical development.

- The third part (Chapters 3.0 to 7.0) discusses the results of the survey of firms in the industry and incorporates the interview findings with industry experts. These chapters cover:

  - a review of recent and anticipated technology adoptions,

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1 Manpower and Employment Implications of New Technologies in Selected Manufacturing Industries in Ontario to 1995. The terms of reference of this assignment can be found in Appendix 3 to the Task Force's final report.

2 1970, Standard Industrial Classification (SIC), Statistics Canada.

- the outlook for the industry to 1995, including expected output and employment levels,

- effects on employment of new technology such as anticipated occupational shifts and changes in required skills,

- a review of the labour relations environment as it relates to new technology, and

- observations on planning efforts for technological change in the industry.

- Part four of the report includes various appendices that support the text of individual chapters.

1.2 Study Approach

The study approach selected incorporates the following research techniques:

- analysis of published statistics and reports on the industry, augmented by the working knowledge of industry specialists within Currie, Coopers & Lybrand,

- in-depth interviews with management and labour experts in the industry, conducted at various stages in the project, using structured interview guides, and

- an industry survey.

The reasons for the choice of these techniques are explained below.

1.2.1 Historical Analysis

The purpose of the historical analysis was to provide an informed perspective on the industry from which to view future trends. The historical analysis covers: the economic environment, competitive factors, output and employment patterns, productivity, technology adoption and the industrial relations environment. In order to permit cross industry analysis, consistent indicators and data sources were used.

1.2.2 Expert Interviews

At various stages in the project, a series of in-depth interviews were conducted with industry leaders, industry associations and union representatives. These experts have a broad understanding of the industry in terms of both its historical development and its future outlook. Their input assisted in the preparation of the historical analysis and in the survey design, and facilitated a clearer interpretation of the survey results.

1.2.3 Sample Survey of Firms

The following describes the key features of the survey.

Ontario firms in the Aircraft and Aircraft Parts Industry were identified using the 1982 Census of Manufacturers.[1] All firms with fifty (50) or more employees were included

[1] Manufacturing Industries of Canada: National and Provincial Areas, 1982, Statistics Canada, Catalogue No. 31-203.

in the sample frame. Employment in these firms is estimated to include 94 percent of the 12,732 employees (1982) in the Aircraft and Aircraft Parts Industry in Ontario.

There were 17 firms in the industry in 1982[1] which had fifty or more employees. This group of firms, with fifty or more employees, was the base for selecting a sample of firms for the survey. Table 1 shows the number of firms in the sample frame, by size.

A representative, random sample of firms, stratified by employment size categories (see Appendix A), was chosen from the sample frame. The senior executive officer of each firm was identified and a structured questionnaire was sent to this individual.

A search was carried out of the Ontario Ministry of Labour Collective Agreements Library to identify unions in the sample firms. Union head offices were contacted to identify the appropriate union leader in each of the unionized firms in the sample. The same questionnaire was sent to union representatives. A copy of the survey questionnaire is attached as Appendix B, together with an outline of the number of responses by question.

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1 The number of firms should not be confused with the number of establishments (51 in 1982). Establishments are production centres. Therefore, a firm may have more than one establishment.

Consultants provided ongoing assistance to respondents, both on the telephone and in person, to complete the questionnaires. The questionnaire survey process generally ended with a personal interview. The number of firms and unions who participated in the sample survey are shown in Table 1.

TABLE 1: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

Firms by Employment Size	Number of Firms and Unions Responding By Firm Employment Size		
	Firms	Unions	Firms in Sample Frame (1)
Small (50-99)	2	0	5
Medium (100-499)	3	0	5
Large (500+)	5	5	7
Total Firms	10	5	17

(1) SOURCE: Statistics Canada, CENSUS OF MANUFACTURERS, 1982.

In most cases, several participants in each organization contributed to the completion of a questionnaire. In the Aircraft and Aircraft Parts Industry survey, an average of 1.0 participants contributed to both the firm and union questionnaire. The companies' principal participants had an average of 14 years' experience with their firms and 11 years in the industry. The unions' principal participants had an average of 25 years experience with their firms and 26 years in the industry.

The sample survey results have been weighted up to the number of firms in the sample frame. That is, the survey results reported herein refer to the weighted survey results and are, therefore, representative of firms with fifty or more employees in the Aircraft and Aircraft Parts

Industry (SIC 321) in Ontario. Reliability of the sample is estimated at 95 percent, with a 7 percent allowable error. See Appendix C for an explanation of the sample reliability calculation method.

Readers should be cautioned about the nature and reliability of the sample survey results. The questionnaire included a set of questions asking respondents about the future (i.e., five and ten years ahead) from a particular point in time. The results are, therefore, a representative sample of views about, and expectations for, the future and should not be viewed as what will necessarily take place. The survey provides a useful perspective from which to better understand how the industry perceives the future of new technology adoption and its anticipated impacts on employment.

The next chapter of the report discusses the historical analysis and subsequent chapters review the results of the sample survey and expert consultation which discuss the anticipated trends for the period 1985 to 1995.

PART II - HISTORICAL TRENDS 1971-1984

2.0 INTRODUCTION

This section of the report provides an historical analysis of the aircraft and aircraft parts manufacturing industry trends for the period 1971 to 1981 and 1982 to 1984.

2.1 The Structure of the Industry

The aircraft and aircraft parts manufacturing SIC 321 includes establishments such as The DeHavilland Aircraft of Canada Ltd., McDonnel Douglas Canada Ltd. and Spar Aerospace Limited. These and the other companies included in SIC 321 are primarily engaged in manufacturing airplanes, gliders, balloons and aircraft parts, such as engines, propellers and pontoons. Aircraft repair is also included in this industry, as are establishments primarily engaged in manufacturing parts for guided missiles and space vehicles. Not included in this industry is the manufacture of aeronautical instruments and air-cushioned vehicles. These latter products are classified under other SIC codes.

In 1982, there were 51 establishments in the aircraft and aircraft parts manufacturing industry (SIC 321) in Ontario. These 51 establishments generated $835.5 million in manufacturing shipments that year, about 38 percent of total output in Canada by SIC 321.

Table D.1 (Appendix D) lists the major products of the aircraft and aircraft parts industry in Canada in order of importance. The manufacture of aircraft and aircraft parts represented nearly 77 percent of shipments in 1981 followed by modifications, conversions, servicing, overhaul and repairs to aircraft engines.

2.2 The Market Environment

Since World War II, the Canadian aerospace industry has developed expertise in, and has successfully marketed, equipment and systems in several broad categories such as stol (short take-off and landing) transport simulators, small gas turbine surveillance drones, etc. During the 1970's, the Canadian Aircraft and Aircraft Parts Industry has increasingly become aware of the fact that it is part of a world industry. Prior to World War II, only half a dozen countries in North America and Western Europe had established comprehensive aerospace industries. However, over the past twenty-five years, aircraft manufacturing plants have been installed throughout the developing world. These countries include Indonesia, India, Brazil and Romania. These countries have established facilities in recognition of the important developmental role of the aerospace industry on national industrial strategies.

During much of the 1970's, both civil and military aircraft manufacturers enjoyed an era of strong growth as military expenditures rose and the demand for civil aircraft rose substantially in response to both business and vacation travel. The 1960's and 1970's represented an era of substantial growth world wide.

The oil shocks of the 1970's, which raised the cost of air travel, were followed by the severe world recession of 1981/1982 resulting in a serious contraction in the profitability of the aircraft industry world wide. This resulted in increased international competition particularly in engine manufacturing. The United States military procurement practices calling for competitive sourcing and the European desire for self-sufficiency is stimulating this environment. The major response by engine manufacturers to this changing environment has been the forming of partnerships, joint ventures and collaborations.

During the first half of the 1980's, intense competition has developed between the large engine and aircraft companies. In 1984, there are only three engine manufacturers left world wide, all of whom are involved in extensive collaborations. On the aircraft side, Lockheed has gone out of the commercial market, McDonnel Douglas appears to be narrowing its focus, Boeing is collaborating with Japan and others, while Airbus consists of many partners.

In the general aviation market, there are many engine and aircraft manufacturers. In the past several years, many of the new industrialized countries have also entered this market. Over the next ten years, it is anticipated that more collaborative efforts and mergers will take place and the product lines of some of the manufacturers will narrow.

Canada's Aircraft and Aircraft Parts Industry, with a relatively small domestic market and limited industrial capacity, recognizes that it cannot successfully compete across the board with the United States' giants and will also have difficulty competing with countries like Brazil.

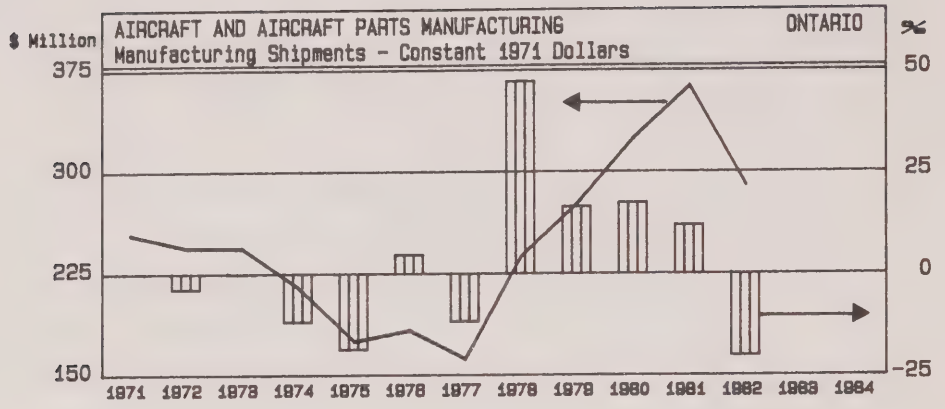
The Canadian industry is therefore pursuing a program of selecting niche markets and the development of more joint ventures. However, to be successful, it is essential that the Canadian industry is modernized, that it identify the technical opportunities at an early stage, that it has adequate access to R&D funding and develop a strong competitive position in the areas of the business chosen.

2.3 Industry Trends

Tables D.2 to D.5 present key industry indicators for the years 1971 to 1984. The tables for this section of the report are presented in Appendix D, Historical Tables.

2.3.1 Aggregate Output

EXHIBIT 1



Current dollar manufacturing shipments of the aircraft and aircraft parts manufacturing industry in Ontario increased from $253 million in 1971 to $987.6 million in 1981. In 1982, manufacturing shipments declined by 15.4 percent to $835.5 million in current dollars.

In constant 1971 dollars, manufacturing shipments of the aircraft and aircraft parts manufacturing industry increased from $253.0 million in 1971 to $362.6 million in 1981. This increase translates into an average annual rate of growth in constant 1971 dollar shipments of 3.7 percent over the 1971 to 1981 period. However, the pattern of activity differed in the first half of the decade compared to the latter half of the period.

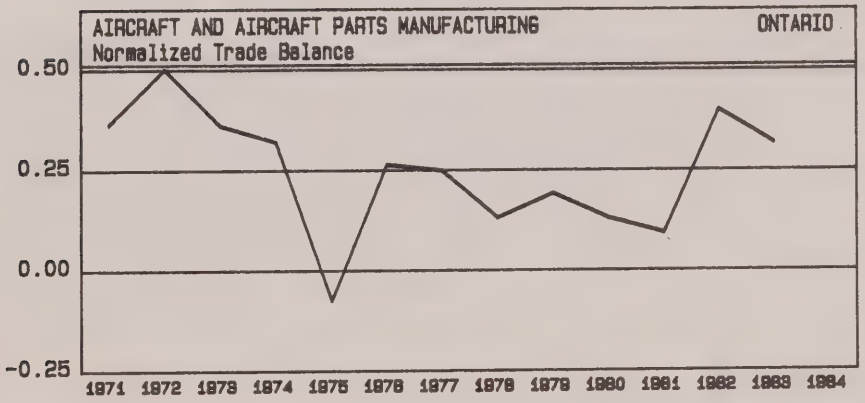
In the period from 1971 to 1977, constant dollar manufacturing shipments declined at an average annual rate of 7.3 percent from $253.0 million to $161.0 million. By contrast, from 1977 to 1981, manufacturing shipments increased at an average annual rate of 22.5 percent from a low for the decade of $161.0 million to a peak for the decade of $362.6 million.

In 1982, constant dollar manufacturing shipments of the aircraft and aircraft parts manufacturing industry experienced a sharp decline of 20.2 percent from $362.6 million in 1981 to $289.3 million in 1982.

2.3.2 Competitive Position

Since 1971, the value of Ontario's exports of aircraft and aircraft parts has exceeded the value of imports in every year except 1975. As a result, Ontario's normalized trade balance (exports minus imports divided by exports plus imports) has been positive in twelve of the last thirteen years.

EXHIBIT 2



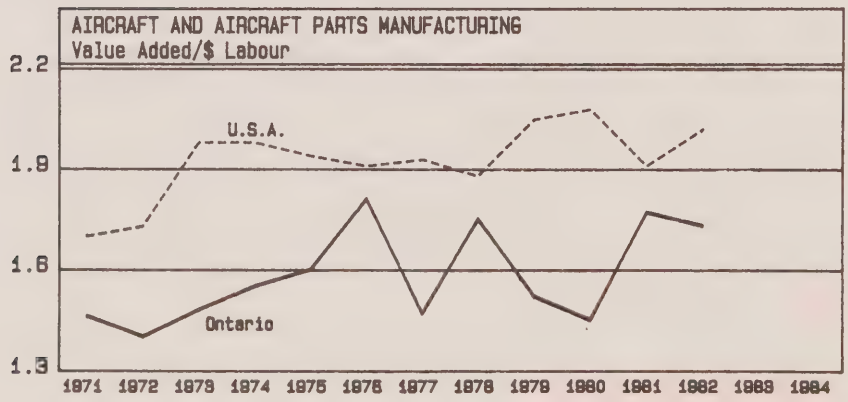
Ontario's normalized trade balance in aircraft and aircraft parts reached a peak for the 1971 to 1983 period in 1972. At that time, exports exceeded imports by a three to one ratio. From 1972 through 1975, imports of aircraft and aircraft parts increased from $96.7 million to $176.7 million while exports declined from $289.8 million to $151.5 million. As a result, Ontario's normalized trade balance declined sharply to negative levels by 1975.

From 1975 through 1982, Ontario's normalized trade balance trended upward as exports averaged stronger annual rates of growth compared to imports. In current dollars, exports increased from $151.5 million in 1975 to $716.1 million in 1982, averaging annual rates of increase of 24.8 percent over the seven year period. Imports, by comparison, increased from $176.7 million in 1975 to $308.4 million in 1982, averaging annual rates of increase of 8.3 percent over the period.

In 1982, Ontario's normalized trade balance turned downward once again. In that year, current dollar exports declined by 28.4 percent to $512.9 million while current dollar imports declined by a smaller 13.3 percent to $267.2 million. As a result, Ontario's positive trade balance as a percent of total trade declined from 1982 levels.

The performance of Ontario's Aircraft and Aircraft Parts Industry can be compared to the industry in the United States based on an analysis of value added per dollar of labour. Exhibit 3 below illustrates that, in Ontario, value added per dollar of labour fluctuated between 70 and 95 percent of the United States figure for the period 1971 through 1982. The smallest differential occurred in 1976 while the largest differential was recorded in 1980.

EXHIBIT 3



In Ontario, value added per dollar of labour increased from $1.46 in 1971 to a peak for the decade at $1.81 in 1976 before gyrating wildly through the latter half of the 1970's. In 1981, value added per dollar of labour was $1.77. In 1982, the ratio fell off slightly to $1.73.

2.3.3 Capital Investment

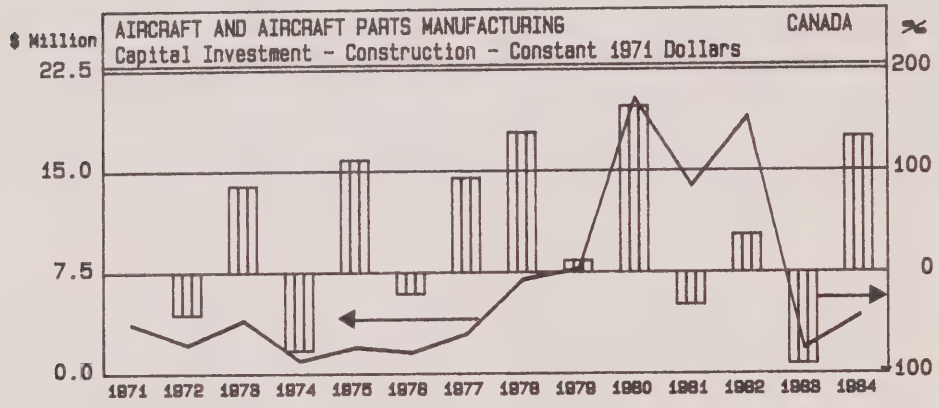
Capital investment statistics are only available for Canada as a whole for SIC 321; however, in 1971, Ontario based manufacturers of aircraft and aircraft parts accounted for 52.8 percent of Canadian shipments of these products. Although this percentage figure slipped to 40.1 percent by 1981 and to 38.1 percent in 1982, Ontario based manufacturers nonetheless represented a major segment of the Canadian Aircraft and Aircraft Parts Industry over the period under review.

In current dollars, total capital spending by the Aircraft and Aircraft Parts Industry increased from $9.9 million in 1971 to $96.5 million in 1981. From 1982 to 1984, total capital spending increased from 1981 levels to $120.7 million in 1982 and then fell to an expected $94.8 million in 1984.

In constant 1971 dollars, total capital spending by the Aircraft and Aircraft Parts Industry increased from $9.9 million in 1971 to $39.5 million in 1981, averaging annual rates of increase of 14.8 percent over the decade. Total capital spending reached a peak for the decade in 1980 at $50.8 million before declining by 22.2 percent to 1981 levels of $39.5 million. From 1982 to 1984, total constant dollar capital spending increased from 1981 levels to $45.4 million in 1982 before averaging annual rates of decline of 14.4 percent to an expected 1984 level of $33.3 million.

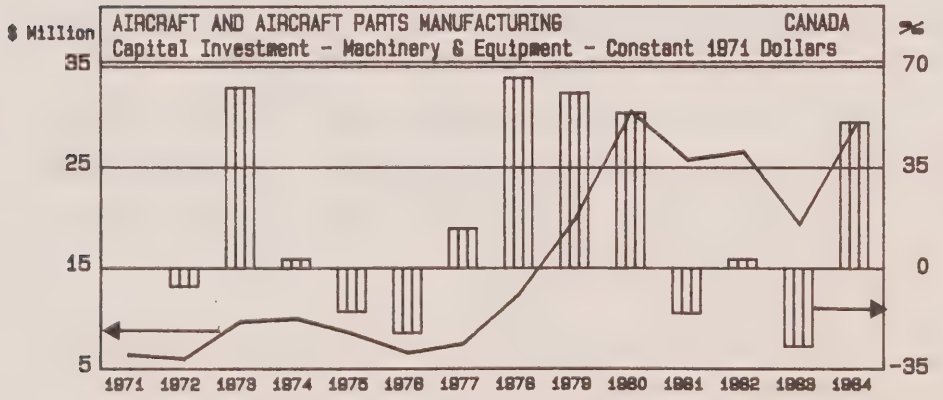
Over the 1971 to 1981 period, the pattern of capital spending for the construction and machinery and equipment components was similar; however, the machinery and equipment component dominated capital expenditures in terms of dollars spent. From 1982 to 1984, the machinery and equipment component became even more dominant as construction activity fell off dramatically, while machinery and equipment spending held up reasonably well by comparison.

EXHIBIT 4



In constant 1971 dollars, capital spending on construction increased from $3.6 million to $13.8 million from 1971 to 1981, an average annual rate of increase of 14.4 percent. From 1982 to 1984, construction spending increased to $18.9 million in 1982 before falling to an expected $4.2 million in 1984.

EXHIBIT 5



In current dollars, capital spending on machinery and equipment increased from $6.3 million in 1971 to $62.2 million in 1981, reaching a high for the 1971 to 1981 period of $66.2 million in 1980. From 1982 to 1984, machinery and equipment spending continued to increase to $69.3 million in 1982 and then to an expected $82.6 million in 1984.

In constant 1971 dollars, capital spending on machinery and equipment increased from $6.3 million to $25.7 million from 1971 to 1981, an average annual rate of increase of 15.1 percent. From 1982 to 1984, machinery and equipment spending increased to $26.5 million in 1982 and then to an expected $29.1 million in 1984.

2.3.4 Employment

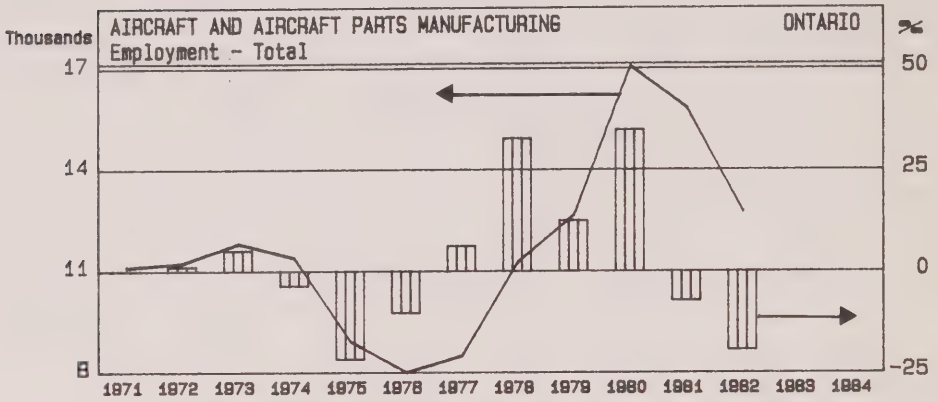
The discussion of employment includes an analysis of aggregate trends and occupational changes.

- Aggregate Trends

  In this section of the report two sources of employment data are used in order to provide the level of analysis required. Total employment trends are taken from Statistics Canada, Manufacturing Industries of Canada: National and Provincial Areas, Cat. No. 31-203. This data series is based on the Census of manufacturing industries conducted by Statistics Canada annually. This data series is used as it shows the year to year trend in total employment. In order to analyze the employment trends by occupation, the Census of Canada has been used. However, this data is only available for the

census years 1971 and 1981. These two series differ because of differences in coverage and methodology and this should be noted.

EXHIBIT 6



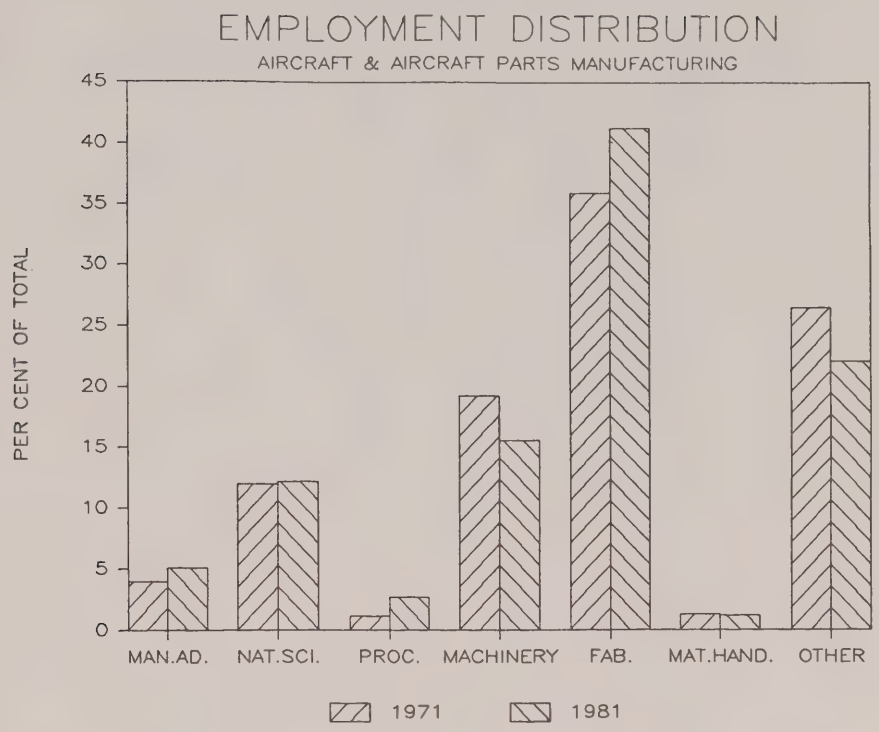
Total employment in the aircraft and aircraft parts manufacturing industries in Ontario grew from 11,091 employees in 1971 to 15,800 employees in 1981. This resulted in an average annual growth rate of 3.6 percent. In 1982, the level of employment dropped over 19 percent to 12,732 employees.

The industry employment is highly sensitive and responds quickly to the general economic conditions, slumping in the recession years, and growing quickly in favourable conditions.

In the two major economic downturns between 1974/1975 and 1981/1982, employment levels fell by approximately 20 percent, while between 1978 and 1980, there were three successive increases of 32.7 percent, 12.5 percent and 34.8 percent respectively.

o Occupational Changes

EXHIBIT 7



Census data for aircraft and aircraft parts manufacturers in Ontario indicates that Product Fabricating, Assembling and Repairing exhibited the most growth in the 1971 to 1981 period, accounting for over 41 percent of total employment in 1981. Small increases in proportional employment were also evident in three other occupational groups (as indicated in Exhibit 7) while Machining and Related, Material Handling and Other categories exhibited declines. Over two-thirds of the Other category was made up of clerical workers in 1981.

According to census data, the overall employment level in aircraft and aircraft parts manufacturing in Ontario grew at an average annual rate of 2.7 percent between 1971 and 1981. In 1981, 15,305 persons were employed in the Aircraft and Aircraft Parts Industry in Ontario. Table D.6 indicates that the fastest growing occupation by far was Processing with an

average annual rate of increase of 12.2 percent from 1971 to 1981. This group was also one of the smallest groups, employing only 410 people in 1981. The largest occupational group, accounting for over 40 percent of total employment in aircraft and aircraft parts manufacturing in 1981, was Product Fabricating, Assembling and Repairing. This group experienced a moderate average annual growth rate of 4.1 percent from 1971 to 1981. Another large group experiencing slow growth from 1971 to 1981 was Machining and Related occupations. This group had 2,380 employees in 1981 and grew at an average annual rate of only 0.5 percent from 1971 to 1981. Natural Sciences, Engineering and Mathematics occupations grew at a slightly stronger rate on average than the average industry growth rate and accounted for 12.2 percent of total employment in 1981. Material Handling and Related occupations were the smallest occupational group in 1981 and their share of total employment decreased over the decade. Managerial, Administrative and Related positions, though not a large group, experienced the second highest average annual growth rate of 5.3 percent from 1971 to 1981.

Within Product Fabricating, Assembling and Repair, the category that experienced the strongest increase in numbers employed from 1971 to 1981 was electrical and related equipment installing and repairing, n.e.c. This category experienced an average annual growth rate of 14.2 percent from 1971 to 1981 and claimed 340 employees in 1981.

The largest category within Product Fabricating, Assembling and Repairing in 1981 was aircraft fabricating and assembling, n.e.c., with just over 48 percent of total employment in this group. This category exhibited a modest average annual growth

rate of 3.3 percent from 1971 to 1981. The only category to experience a decline, of 0.4 percent, was foremen: mechanics and repairmen, which was not a proportionately significant category, accounting for under two percent of the jobs in the product fabricating group. Within Machining and Related occupations, the largest group was machinists and machine-tool setting up, accounting for 32.1 percent of total employment in this field, and having the highest average annual growth rate of 6.6 percent from 1971 to 1981. Tool and die makers (215 employees in 1981) and machine tool operators (250 employees in 1981) showed the largest average annual declines of 7.4 percent and 7.0 percent respectively from 1971 to 1981.

In the Natural Sciences, Engineering and Mathematics occupations, the three largest categories, totalling almost 60 percent of employment in this group, experienced the highest average annual growth rates from 1971 to 1981. The largest group was aerospace engineers (565 employees in 1981) with an average annual growth rate of 6.7 percent from 1971 to 1981, followed by architectural and engineering technologists and technicians (350 employees in 1981) with an average annual growth rate of 5.8 percent from 1971 to 1981, and systems analysts, computer programmers and related (200 employees in 1981) with the highest average annual growth rate of 8.3 percent from 1971 to 1981. The two categories to experience declines in numbers employed were mechanical engineers and industrial engineers which were also the two smallest occupational categories in that group in 1981.

Metal processing and related occupations, which included 225 employees in 1981, experienced the highest average annual growth of any occupational category from 1971 to 1981 - of 36.5 percent. This compared to an average annual growth rate of 12.2 percent for Processing occupations in general.

Within the Managerial, Administrative and Related occupations, purchasing officers and buyers, except wholesale and retail trade declined at an average annual rate of 0.4 percent from 1971 to 1981. Accountants, auditors and other financial officers experienced average annual growth slightly higher than that of the group in general at 5.7 percent over the decade. These two categories accounted for less than one-third of occupations in this field.

Table D.7 indicates that women were represented in 2,020 jobs in the Aircraft and Aircraft Parts Industry in 1981, an increase of 845 jobs since 1971. Although women improved their position within the industry, women only constituted 13.2 percent of total employment in 1981 compared to 10.0 percent in 1971.

Most women were employed in Product Fabricating, Assembling and Repair, but this area also had one the lowest shares of total employment for women, at 6.2 percent. Women were most prominent in Managerial and Administrative jobs, (12.7 percent of total), more than doubling their share of jobs in this area from 1971 (5.3 percent). The only decrease in the number of positions held by women was in Material Handling and Related; however, this category was the least significant occupation employing only 15 women in 1981. In other areas, such as machining, women also increased their participation.

PART III - FUTURE TRENDS: THE SURVEY RESULTS

Part III of this study presents the survey results which discuss the firms' surveyed opinions as to future trends in technology adoption and employment impacts.

3.0 ADOPTION OF NEW TECHNOLOGY

This chapter reviews the expected trends in the adoption of new technology in the Aircraft and Aircraft Parts Industry and the factors driving the need for and affecting the rate of technology adoption.

3.1 New Technologies and Rates of Adoption

The aircraft industry manufactures a variety of high quality products and provides services such as modifying and converting existing products which require precision. As a result, the industry has a strong interest in new technology. The industry is already taking advantage of new technology in such areas as manufacturing, planning and control and manufacturing processes. The pace of new technology adoption will continue in the 1985 to 1990 period, by which time the majority of the industry will have adopted much of the known technology.

Design technologies have yet to make a strong impact in the industry, except for large firms. However, the next five years will see widespread acquisition of new systems. Further acquisitions are also planned for the 1990's. The same is true of telecommunications technologies, where large firms are leading the way.

In contrast, the industry does not plan to take advantage of materials handling technologies now available. Firms in the industry usually do not have the same need for these systems as do other manufacturing industries because production does not take place in long runs as a rule.

Results of Question 3

TABLE 2: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

SIC 321

Percent of Firms Planning to Adopt New Technologies by Employment Size (1)

Technologies	Before 1985				1985-1990				1990-1995			
	Small	Medium	Large	Total	Small	Medium	Large	Total	Small	Medium	Large	Total
1. DESIGN TECHNOLOGIES												
Computer-Aided Design (CAD)	0	0	40	21	100	-	20	37	50	33	-	21
Computer-Aided Engineering (CAE)	0	0	40	21	100	-	20	37	50	33	-	21
CAD/CAM Integration	0	0	40	21	50	-	20	24	-	33	-	7
Other	50	0	0	13	-	33	-	7	-	-	-	-
2. MANUFACTURING PLANNING AND CONTROL TECHNOLOGIES												
Computerized Financial Systems	50	67	100	79	50	-	20	24	-	-	-	-
Computerized Order Entry/Inventory Control	50	100	100	87	50	-	20	24	-	-	-	-
Computer-Aided Process Planning	0	33	60	38	100	67	60	72	-	-	-	-
Manufacturing Resource Planning Systems (MRP)	0	67	60	46	50	-	80	54	-	-	-	-
Automated Shop Floor Data Collection	0	33	40	28	100	67	60	72	-	33	-	7
Computerized Decision Support Systems	0	0	40	21	50	33	60	52	-	-	-	-
Computerized Maintenance Planning and Control	0	0	40	21	50	67	80	69	-	-	-	-
Other	0	0	20	10	-	-	-	-	-	-	-	-
3. MANUFACTURING PROCESS TECHNOLOGIES												
"Fly-by-Wire" Avionics	0	0	0	0	-	-	-	-	-	-	40	21
Carbon Fiber Composites/Exotic Alloys	50	0	40	34	-	33	20	18	-	-	-	-
Numerically Controlled Machines (NC)	100	100	100	100	-	-	-	-	-	-	-	-
Computer Controlled CN Machines (CNC)	100	100	100	100	-	-	-	-	-	-	-	-
CAD Directed CNC	0	0	20	10	50	-	40	34	-	-	-	-
Computerized Process Control Systems	0	67	40	35	100	33	40	54	50	-	-	13
Computer-Aided Inspection and Testing	100	33	80	75	-	67	40	35	-	-	-	-
Robotic Applications	0	0	20	10	-	-	60	31	-	33	40	28
Flexible Manufacturing Technologies	0	0	20	10	-	100	40	43	-	33	20	18
Computer Integrated Manufacturing (CIM)	0	33	20	18	50	33	40	41	-	33	-	7
Other	0	0	20	10	50	-	-	13	-	-	-	-
4. MATERIALS HANDLING TECHNOLOGIES												
Automatic Bulk Handlers/Feeder Systems	0	0	20	10	-	-	-	-	-	-	-	-
Automated Conveyor/Vehicle Systems	0	0	40	21	-	-	-	-	-	-	-	-
Automated Storage and Retrieval	0	0	0	0	-	33	-	7	-	-	-	-
Computer Controlled Conveyor/Vehicles	0	0	0	0	-	-	-	-	-	-	-	-
Automated Warehouse	0	0	0	0	-	33	-	7	-	-	-	-
Other	0	0	0	0	-	-	-	-	-	-	-	-
5. TELECOMMUNICATIONS TECHNOLOGIES												
Facsimile (FAX) Link: HO/Plant(s)	0	67	60	46	50	-	40	34	-	-	-	-
Computer Link: HO/Plant(s)	50	0	60	44	50	-	40	34	50	-	-	13
Computer Link: Suppliers/Customers	0	0	40	21	-	-	40	21	50	-	20	24
Other	0	0	0	0	-	-	-	-	-	-	-	-
6. OTHER TECHNOLOGIES	0	33	0	7	-	-	-	-	-	-	-	-

(1) '0' used prior to 1985 to indicate have not adopted. '-' used for periods 1985-1990 and 1990-1995 to indicate respondents, at the time of the survey, are not planning to adopt this technology or 'don't know'. Responses are not mutally exclusive.

Table 2, opposite, summarizes the percentage of firms who have adopted new technologies before 1985, or will by 1990, or will after 1990 but before 1995. The following comments provide observations on the survey findings.

3.1.1 Design Technologies

Large firms have led the way in adopting computer aided design and engineering technology, with 40 percent of these firms already using them. By 1990, 60 percent of large firms will have adopted these technologies, but no further penetration is expected. Small firms will purchase these systems in the 1985-1990 period. Firms with 100 to 499 employees will not be introducing computers in general, with only 33 percent considering purchase before 1995.

3.1.2 Manufacturing Planning and Control Technologies

Computers have been put to use by over 70 percent of the industry in financial planning, ordering and inventory applications. During the next five years they will be introduced into process planning, maintenance planning, decision support and shop floor data applications. Large firms have led in acquiring these systems, but the spread of "micro" computers has brought the new technology within range of the smallest firms. By 1990, between 70 and 100 percent of the industry will have likely adopted most of the systems available to assist in planning and control tasks.

3.1.3 Manufacturing Process Technologies

Much new technology has already been acquired to aid directly in manufacturing. The entire industry has in place computer controlled and numerically controlled machinery. Most firms also have applied computers to

inspection and testing tasks. Over 75 percent of the industry uses these systems of quality checking.

The 1985-1990 period will see further significant purchases by firms of all sizes. New materials such as carbon fiber composites will continue to be introduced with 52 percent of the industry expecting to use them by 1990. Flexible manufacturing technologies and computer integrated manufacturing will also become common.

The industry will stretch acquisition of other new technology out to 1995, although large firms have begun some purchases already. Robots have appeared among these large firms and 60 percent of them plan to be using them by 1990, increasing with the remaining firms adopting them by 1995. Flexible manufacturing technologies will be purchased by medium and large sized firms throughout the 1985 to 1995 period but small firms are not expected to take advantage of the systems.

3.1.4 Materials Handling Technologies

Some large firms have found uses for automated bulk handling and conveyor systems but no further penetration of the industry is expected to occur.

Some medium sized firms (100 to 499 employees) are considering automated storage and retrieval and warehousing in the next five years. However, these planned purchases do not change the general lack of opportunity or need for the industry to acquire new technology in this area.

3.1.5 Telecommunications Technologies

This industry is well advanced in applying telecommunication innovations to links between plant and head office. Small firms are expected to go further in

applying this technology than are medium sized firms, with planned purchases concentrated in the next five years. At present, 60 percent of the large firms are using these systems and the rest plan to follow in the next five years. These communications links are being extended to customers and/or suppliers as well in the near future with 50 percent of the small firms by 1995.

3.2 Forces Driving the Need to Adopt New Technology

The forces inducing firms to consider new technology differ by firm size. Table 3 summarizes the firms' responses. Small firms are concerned primarily about improving quality of product and staying competitive. They also wish to ensure that they can respond to their customers' demands for new parts or services.

Medium-sized firms are influenced by a broader range of factors. These include the desire to increase skills with a view to entering new markets and the need to increase profitability. Firms are aware of customers' demands for change as well. New technology is introduced to ensure eligibility for potential business for which a firm must be prepared. For such work as custom-designing of parts, increasing quality demands are met by purchasing machinery and equipment capable of meeting these demands.

Large firms cite the pressure of competition as the dominant force influencing technical change. These firms tend to look to the world, especially the U.S., market for sales, making them consider their costs in relation to other firms which may manufacture on a larger scale. They also report the need to be prepared to meet new customer demands.

3.3 Factors That Could Slow the Rate of Technology Adoption

The industry recognizes its vulnerability to the business cycles by identifying poor economic conditions as the most important factor that could retard the introduction of new technology.

Results of Question 4

TABLE 3: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS SIC 321

Most Important Factors Driving the Need to Adopt New Technologies

Factor		Percent of Firms by Employment Size			
		Small (50-99)	Medium (100-499)	Large (500+)	Total Firms
COMPETITIVE PRESSURES	First	50	0	60	43
	Second	0	0	20	10
	Third	0	0	0	0
	Weighted Importance (1)	1.5	0.0	2.2	1.5
STRATEGIC	First	0	33	20	17
	Second	50	0	0	13
	Third	0	0	0	0
	Weighted Importance	1.0	1.0	0.6	0.6
CUSTOMER DEMANDS FOR CHANGES	First	0	33	20	18
	Second	50	0	20	24
	Third	0	33	20	18
	Weighted Importance	1.0	1.3	1.2	1.2
INCREASE PROFITABILITY	First	0	33	0	7
	Second	0	0	0	0
	Third	0	0	0	0
	Weighted Importance	0.0	1.0	0.0	0.2
INCREASE PRODUCTIVITY	First	0	0	0	0
	Second	0	0	0	0
	Third	0	0	20	10
	Weighted Importance	0.0	0.0	0.2	0.1
INCREASE QUALITY	First	50	0	0	13
	Second	0	0	0	0
	Third	0	0	0	0
	Weighted Importance	1.5	0.0	0.0	0.4
LOWER COSTS	First	0	0	0	0
	Second	0	0	20	10
	Third	0	0	0	0
	Weighted Importance	0.0	0.0	0.4	0.2
INCREASE SKILLS/ ORGANIZATIONAL CAPABILITY	First	0	0	0	0
	Second	0	33	0	7
	Third	0	33	0	7
	Weighted Importance	0.0	1.0	0.0	0.2
ENTER NEW MARKETS/ GROWTH	First	0	0	0	0
	Second	0	67	0	15
	Third	0	0	20	10
	Weighted Importance	0.0	1.3	0.2	0.4
OBSOLESCENCE	First	0	0	0	0
	Second	0	0	40	21
	Third	0	0	20	10
	Weighted Importance	0.0	0.0	1.0	0.5
ALL OTHERS	First	0	0	0	0
	Second	0	0	0	0
	Third	0	0	20	10
	Weighted Importance	0.0	0.0	0.2	0.1

(1) Weighted Importance = (First % x 3) + (Second % x 2) + (Third % x 1)

Results of Question 5

TABLE 4: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS SIC 321

Most Important Factors that Could Slow the Rate of New Technology Adoption

Factor		Percent of Firms by Employment Size			
		Small (50-99)	Medium (100-499)	Large (500+)	Total Firms
ABILITY TO FINANCE	First	0	0	40	21
	Second	0	0	20	10
	Third	50	0	20	24
	Weighted Importance (1)	0.5	0.0	1.8	1.1
COST OF NEW TECHNOLOGY	First	50	0	40	34
	Second	0	0	0	0
	Third	0	0	0	0
	Weighted Importance	1.5	0.0	1.2	1.0
LACK OF GOVERNMENT ASSISTANCE	First	0	0	0	0
	Second	50	0	20	24
	Third	0	0	0	0
	Weighted Importance	1.0	0.0	0.4	0.5
POOR ECONOMIC CONDITIONS	First	50	67	20	38
	Second	50	33	40	41
	Third	0	0	0	0
	Weighted Importance	2.5	2.7	1.4	2.0
UNION RESISTANCE	First	0	0	0	0
	Second	0	0	20	10
	Third	0	0	0	0
	Weighted Importance	0.0	0.0	0.4	0.2
LACK OF SKILLS AND/OR KNOW-HOW TO IMPLEMENT	First	0	0	0	0
	Second	0	33	0	7
	Third	0	0	40	21
	Weighted Importance	0.0	0.7	0.4	0.4
LACK OF NEW TECHNOLOGY STANDARDIZATION	First	0	0	0	0
	Second	0	0	0	0
	Third	0	67	0	15
	Weighted Importance	0.0	0.7	0.0	0.2
UNWILLINGNESS TO CHANGE	First	0	33	0	7
	Second	0	33	0	7
	Third	0	0	0	0
	Weighted Importance	0.0	1.7	0.0	0.4

(1) Weighted Importance = (First % x 3) + (Second % x 2) + (Third % x 1)

Firms of all sizes experience a sharp drop-off in orders in recession, as was demonstrated by the years 1981-1983.

Small and large firms both cite the cost of new technology as being a potential limiting factor in future. For small firms, there is difficulty reaching the scale of operations necessary to generate revenue sufficient to pay off the investment cost in a reasonable time. For large firms, the problem appears to have been the recent experience of the recession, which has restricted their ability to raise funds.

Medium sized firms mention the problems of acquiring skills necessary to use new technology, but also refer to customer resistance to new products or to product quality offered by new technology. Apparently, while some customers press firms to be innovative, others may complain about inability to continue purchasing replacement parts for existing equipment at the same cost or with the same specifications as in previous orders.

Table 4 summarizes the views expressed by survey participants regarding potential retarding influences on technology adoption.

4.0 INDUSTRY OUTLOOK TO 1995

This chapter reviews the anticipated outlook for the industry in terms of aggregate output (i.e., manufacturing shipments in Ontario), investment plans, employment and changes in occupational structure to 1995.

4.1 Output to 1995

Very diverse views about future output growth were found in the industry. The industry sees the 1983-1985 period as one of rapid recovery from the recession, with small firms seeing the highest growth rate for the year 1985. Medium sized firms are optimistic about future shipments growth to 1995, relative to both large and small firms, while small firms appear to be the most pessimistic. However, the industry is unanimous in its belief in strong future growth for the entire industry when compared with other manufacturing sectors in Ontario. The industry expects rapid expansion in shipments in 1985 of 9 percent and continued growth in the 1985-1990 period at about 7.5 percent per year. Since small firms expect slower growth in the 1990's then for the previous five years, the expected growth rate slows to 7.0 percent. Other firms see continued rapid growth at the pace set in the late 1980's.

The survey respondents' views are presented in Table 5.

4.2 Investment Patterns

The survey results suggest that 80 percent plus of total capital spending will be in machinery and equipment. While little construction investment is expected to be related to new technology, more than half of the machinery and equipment investment is expected to be related to new technology.

Results of Question 1

TABLE 5: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS SIC 321

Manufacturing Shipments in Ontario

Average Annual Compound Rate of Change (in Constant Dollars) (1)

Firms by Employment Size	Estimated 1982-1983	Estimated 1983-1984	Estimated 1984-1985	Expected 1985-1990	Expected 1990-1995
Small (50-99)	0.0	5.0	12.5	6.5	4.0
Medium (100-499)	-9.0	17.5	8.5	10.0	10.0
Large (500+)	-4.5	10.0	6.5	7.0	7.0
Total Firms	-4.5	10.5	9.0	7.5	7.0

(1) Rounded to closest 0.5%

4.2.1 Justifying Financial Investment in New Technology

The criterion in widest use for evaluating investment in new technology is return on investment. On average, the industry requires a return of 60 percent to justify devoting funds to the purchase of new plant and equipment with a new technology component. However, the acceptable rate may vary from firm to firm.

About half the industry sets a pay-back limit on investment but, here again, length varies widely. Even though small firms allow up to five years to pay off a purchase of new technology, it is sometimes inadequate to justify purchases that larger firms would approve. This view was expressed above in reference to factors slowing the rate of adoption of new technology. The survey results are tabulated in Table 6.

4.2.2 Source of New Capital Spending

The industry plans to finance about 62 percent of its purchases of new technology by internal means in the coming decade. However, as may be seen in Table 7, there is a sharp difference between small firm's plans and those of other firms. Internal financing will provide all of the funds for firms with 100 to 499 employees and 80 percent of large firms' needs. However, small firms will require external funds for 78 percent of their capital requirements.

Results of Question 17e

TABLE 6: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS — SIC 321

Justifying Financial Investment in New Technology

Firms by Employment Size	Pay-Back Period: % of Firms Using Pay-Back	Pay-Back Period: Average Period	Return on Investment: % of Firms Using ROI	Return on Investment: Average Rate
				Percent
Small (50-99)	50	5 years	50	20.0
Medium (100-499)	0	-	100	20.0
Large (500+)	60	3 years	60	22.0
Total Firms	52	3 years	60	21.0

Answers are not mutually exclusive.

Results of Question 17f

TABLE 7: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS — SIC 321

Source of Funds for New Technology Spending

Firms by Employment Size	Internal Funds	External Funds
	Percent	Percent
Small (50-99)	22	78
Medium (100-499)	100	0
Large (500+)	80	20
Total Firms	62	38

4.3 Employment to 1995

This section reviews expected trends in employment patterns and analyses factors affecting aggregate employment.

4.3.1 Factors Affecting Employment

The factors mentioned by the survey respondents as affecting employment levels belong to two main groups: market conditions and availability of skills among employees in the work force).

Different market conditions are important to different groups of firms. Small firms believe that overall growth of the economy and firms' ability to maintain their share of industry sales are most significant. Medium sized firms feel "competitiveness" within the industry and industry growth are the most important employment factors. Large firms have a perspective somewhat different from other firms due to the importance of their sales to the American market, including the armed forces. The growth of domestic demand for aircraft and related parts is a secondary but important consideration in employment growth.

Employment is also viewed as depending upon the introduction of new technology. Industry executives feel new technology is often the key to attracting customers and sustaining or enlarging their work force. A possible restraining factor mentioned by large and medium sized firms is the question of whether enough skilled personnel to use the new technology will be available.

Results of Question 11a,b,c

TABLE 8: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS — SIC 321

Most Important Factors Affecting The Firms' Employment in Ontario

Factor		Percent of Firms by Employment Size			
		Small (50-99)	Medium (100-499)	Large (500+)	Total Firms
PROFITABILITY/ FINANCIAL STRENGTH	First	0	0	0	0
	Second	0	0	0	0
	Third	50	0	0	15
	Weighted Importance (1)	0.5	0.0	0.0	0.2
INCREASE SALES/ INCREASE MARKET SHARE	First	50	33	0	23
	Second	0	0	25	12
	Third	0	0	0	0
	Weighted Importance	1.5	1.0	0.5	0.9
INTRODUCTION OF NEW TECHNOLOGY	First	0	0	0	0
	Second	50	33	25	34
	Third	0	0	0	0
	Weighted Importance	1.0	0.7	0.5	0.7
SUCCESS IN FOREIGN MARKETS	First	0	0	75	34
	Second	0	0	0	0
	Third	0	0	0	0
	Weighted Importance	0.0	0.0	2.3	1.0
AVAILABILITY OF NECESSARY SKILLS	First	0	0	0	0
	Second	0	0	25	12
	Third	0	33	0	8
	Weighted Importance	0.0	0.3	0.5	0.3
ABILITY TO COMPETE	First	0	33	0	8
	Second	0	33	0	20
	Third	0	0	25	12
	Weighted Importance	0.0	1.7	0.8	0.8
INDUSTRY-WIDE GROWTH	First	0	33	25	20
	Second	0	0	0	0
	Third	0	0	25	12
	Weighted Importance	0.0	1.0	1.0	0.7
OVERALL ECONOMIC GROWTH	First	50	0	0	15
	Second	0	0	0	0
	Third	0	0	0	0
	Weighted Importance	1.5	0.0	0.0	0.4
FOREIGN EXCHANGE RATE/CANADIAN COMPETITIVENESS	First	0	0	0	0
	Second	0	0	0	0
	Third	0	0	25	12
	Weighted Importance	0.0	0.0	0.3	0.1
ALL OTHERS	First	0	0	0	0
	Second	50	0	0	15
	Third	0	0	25	12
	Weighted Importance	1.0	0.0	0.3	0.4

(1) Weighted Importance = (First % x 3) + (Second % x 2) + (Third % x 1)

Results of Question 11d

TABLE 9: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS — SIC 321

Firms' Employment Trends in Ontario

Firms by Employment Size	Total Employment and Average Annual Compound Rate of Change (1)			
	Estimated Rate		Expected Rate	
	1981-1984	1984-1985	1985-1990	1990-1995
Small (50-99)	4.0	22.0	6.0	0.5
Medium (100-499)	10.5	7.0	6.0	3.5
Large (500+)	-9.5	9.5	-2.0	1.0
Total Firms	-7.5	9.5	-0.5	1.0

(1) Rounded to closest 0.5%.

Results of Question 12

TABLE 10: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS — SIC 321

Trends in Firms' Occupational Structure

Occupations	Percent of Total Employment by Selected Occupational Categories				
	Estimated			Expected	
	1981	1984	1985	1990	1995
MANAGERIAL, ADMINISTRATIVE AND RELATED	5.6	7.2	7.2	9.7	9.7
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS	10.0	10.9	10.5	12.3	12.0
• Engineers		+	-	+	+
• Draughtsmen		0	-	+	-
• Engineering Technicians and Technologists		+	0	+	0
• Systems Analysts and Computer Programmers		0	0	+	0
• All Other Science and Mathematics (not listed above)		0	0	0	0
PROCESSING	12.9	14.4	13.7	12.2	11.7
MACHINING	20.2	21.4	21.0	24.8	25.0
• Foremen		0	0	+	+
• Tool and Die Making		0	-	+	+
• Machinist and Machine Tool Setting-Up		+	0	+	+
• Metal Shaping and Forming, Except Machinery		-	-	0	0
• Welding/Soldering		0	0	0	+
• All Other Machining (not listed above)		0	-	0	+
FABRICATING, ASSEMBLING AND REPAIRING	35.4	30.6	29.8	23.8	24.8
• Aircraft Fabricating and Assembling		-	+	-	+
• Inspecting and Testing		0	-	-	+
• Electrical Equipment Installing and Repair		0	0	-	0
• Aircraft Mechanics		0	0	-	0
• All Other Fabricating, Assembling and Repairing (not listed above)		-	0	0	+
MATERIALS HANDLING AND RELATED	6.0	6.6	6.3	6.5	6.1
ALL OTHER OCCUPATIONS	9.9	8.9	11.4	10.9	10.7
TOTAL	100%	100%	100%	100%	100%

4.3.2 Industry-wide Employment Outlook

Employment in the Aircraft and Aircraft Parts Industry grew 3.6 percent a year over the 1971 to 1981 period. During 1982, employment declined sharply as the recession impacted the industry. The survey fundings suggests that these job losses were picked up during 1983 to 1985 (see Table 9). In terms of the future, the firms anticipate a small decline in growth in the 1985 to 1990 period, followed by a modest 1 percent per annum increase during the years 1985-1990. The small and medium sized firms anticipate growth of 6 percent per year between 1985-1990, whereas the large firms foresee contraction in employment levels.

4.3.3 Trends in Part Time Work

Part-time employment is a small proportion of total employment. Survey respondents estimate that about 3.5 percent of total employment was part-time in 1984. The next decade should see little change in this level.

Part-time employment is concentrated in a few firms, which see stable levels of part-time employment. No firms in the sample foresee a significant change in the percentage of employment made up by part-time workers.

4.4 Changes in Occupational Structure

Table 10 shows trends in occupational structure (i.e., percent of total industry employment by occupation) in the Aircraft and Aircraft Parts Industry from 1981 to 1995.

Table 10 suggests:

- a modest increase in Managerial, Administrative and Related occupations, in Natural Sciences, Engineering and Mathematics occupations, and in Machining occupations.

- a decline in employment share in Fabricating, Assembling and Repairing, and in Processing occupations.

- Materials Handling and Related occupations are indicated to remain the same.

In terms of employment totals, all major occupational categories are expected to increase in the number of jobs. The above comments refer only to the anticipated shifts in the proportion of the Ontario industry's work force in these occupational groups.

5.0 EMPLOYMENT EFFECTS OF NEW TECHNOLOGY

This chapter reviews the survey results on the employment effects of new technology in terms of skills match and requirements and impact on skill levels and job content.

5.1 Effects on Occupations

Table 11 shows that firms expect to see shortages develop in most major occupational groups. These firms plan to increase employment sharply in the near future after two years of sustained employment growth. They seek highly skilled workers for Machining and Fabricating positions which require time for training.

Firms expect shortages in all machining occupations as well as managerial positions. However, the survey respondents hold mixed views on hiring conditions in the Natural Sciences, Engineering and Mathematics group. Opinion is split fairly evenly between oversupply and shortage except for engineers and engineering technicians and technologists who are expected to be in short supply by the majority of respondents. These views apply to all size groups of firms.

Fabricating occupations will also be in short supply. Firms expressed this view tentatively, indicating that whatever shortages develop will probably be modest relative to those in machining and management. However, there are several occupations for which some employers expect an oversupply to develop while others expect a shortage. These occupations are draughtsmen, systems analysts and computer programmers and aircraft fabricating and assembling.

Results of Question 6

TABLE 11: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS — SIC 321

Impact of Technology on Selected Occupations in Firms 1985-1995

Occupations	Percent of Firms		
	Oversupply	Shortage	No Response
MANAGERIAL, ADMINISTRATIVE AND RELATED	0	61	39
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS			
• Engineers	15	62	23
• Draughtsmen	34	31	34
• Engineering Technicians and Technologists	15	47	38
• Systems Analysts and Computer Programmers	34	39	26
PROCESSING	20	54	26
MACHINING			
• Foremen	0	88	12
• Tool and Die Making	0	77	23
• Machinist and Machine Tool Setting-Up	0	100	0
• Metal Shaping and Forming, except Machinery	12	53	35
• Welding/Soldering	8	34	57
FABRICATING, ASSEMBLING AND REPAIRING			
• Aircraft Fabricating and Assembling	23	20	57
• Inspecting and Testing	11	46	43
• Electrical Equipment Installing and Repair	0	46	54
• Aircraft Mechanics	0	0	100
MATERIALS HANDLING AND RELATED	8	0	92
OTHER	0	20	80

Results of Question 7

TABLE 12: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

SIC 321

Steps Firms Will Likely Take to Deal With an OVERSUPPLY of Skills
1985-1995

Occupations	Most Commonly Cited	Second Most Common	Third Most Common
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS			
• Engineers	Retrain	Layoff	(1)
• Draughtsmen	Retrain	Layoff	Lateral Transfer
• Engineering Technicians and Technologists	Retrain	Layoff	(1)
• Systems Analysts and Computer Programmers	Retrain	Layoff	Shorter Hours
PROCESSING	Attrition	Layoff	Shorter Hours
MACHINING			
• Metal Shaping and Forming, except Machinery	Layoff	(2)	(2)
• Welding/Soldering	Layoff	(2)	(2)
FABRICATING, ASSEMBLING AND REPAIRING			
• Aircraft Fabricating and Assembling	Layoff	Attrition	Lateral Transfer
• Inspecting and Testing	Upgrade	Retrain	(1)
MATERIALS HANDLING AND RELATED	Retrain	Attrition	(1)

(1) Only two steps mentioned.
(2) Only one step mentioned.

Results of Question 8

TABLE 13: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

SIC 321

Steps Firms Will Likely Take to Deal With a SHORTAGE of Skills
1985-1995

Occupations	Most Commonly Cited	Second Most Common	Third Most Common
MANAGERIAL, ADMINISTRATIVE AND RELATED	Recruit	Upgrade	Retrain
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS			
• Engineers	Recruit	Contract Out	Retrain
• Draughtsmen	Recruit	Retrain	(1)
• Engineering Technicians and Technologists	Recruit	Retrain	Upgrade
• Systems Analysts and Computer Programmers	Recruit	Retrain	Recruit
PROCESSING	Recruit	Retrain	(1)
MACHINING			
• Foremen	Retrain	Recruit	Upgrade
• Tool and Die Making	Recruit	Retrain	Upgrade
• Machinist and Machine Tool Setting-Up	Recruit	Retrain	Upgrade
• Metal Shaping and Forming, except Machinery	Retrain	Recruit	Upgrade
• Welding/Soldering	Retrain	Recruit	Upgrade
FABRICATING, ASSEMBLING AND REPAIRING			
• Aircraft Fabricating and Assembling	Upgrade	Recruit	Retrain
• Inspecting and Testing	Recruit	Upgrade	Retrain
• Electrical Equipment Installing and Repair	Recruit	Upgrade	Contract Out
OTHER	Recruit	Contract Out	(1)

(1) Only two steps mentioned.

5.2 Likely Steps to Deal with Skills Oversupply

Firms identifying occupations likely to experience oversupply in the coming decade also specified actions that they would take to adjust the relevant occupations' employment. Their responses, ranked by frequency of mention, are presented in Table 12. The two most important steps that firms expect to take are to retrain and lay off. Other steps include shortening work hours, allowing the work force to shrink by attrition, transferring workers to new positions, and upgrading them in current positions to new job categories.

There may be a slight difference between steps taken with regard to employees in positions requiring higher educational levels and those occupations requiring less education. The former group, including engineers, draughtsmen and engineering technicians, will first be retrained while those in machinery and fabricating will be laid off. Firm size does not appear as a significant factor in determining the likely action.

It should be noted that the Aircraft and Aircraft Parts Industry does not anticipate a significant oversupply situation.

5.3 Likely Steps to Deal with Skills Shortages

Firms expect shortages in almost every occupation in the industry. Recruiting and retraining will be the most important means of trying to keep up with the firm's needs for skilled employees at all levels. Other commonly cited steps were contracting out certain types of work such as engineering. The survey respondents' views appear in Table 13.

Results of Question 9

TABLE 14: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS SIC 321

Impact of Technology on Skill Levels and Job Content

Occupations	Skills Required (1) Percent of Firms			Time to Achieve Proficiency (1) Percent of Firms			Knowledge of Firm's Operations (1) Percent of Firms		
	+	-	0	+	-	0	+	-	0
MANAGERIAL, ADMINISTRATIVE AND RELATED	91	0	9	54	16	30	62	0	38
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS									
• Engineers	100	0	0	45	19	36	89	0	11
• Draughtsmen	37	13	50	13	50	37	0	13	87
• Engineering Technicians and Technologists	100	0	0	57	15	28	34	0	66
• Systems Analysts and Computer Programmers	100	0	0	58	0	42	89	0	11
PROCESSING	60	20	20	14	46	40	0	0	100
MACHINING									
• Foremen	77	0	23	54	0	46	66	0	34
• Tool and Die Making	39	0	61	26	0	74	26	0	74
• Machinist and Machine Tool Setting-Up	66	26	8	43	26	31	31	12	57
• Metal Shaping and Forming, except Machinery	19	35	46	19	35	46	0	0	100
• Welding/Soldering	11	19	70	11	19	70	0	0	100
FABRICATING, ASSEMBLING AND REPAIRING									
• Aircraft Fabricating and Assembling	48	13	40	30	13	58	12	0	88
• Inspecting and Testing	41	21	38	54	9	37	16	13	71
• Electrical Equipment Installing and Repair	43	10	47	43	10	47	29	0	71
• Aircraft Mechanics	25	18	57	25	18	57	25	0	75
MATERIALS HANDLING AND RELATED	20	0	80	0	0	100	0	0	100
OTHER	0	100	0	0	100	0	0	0	100

+ increase - decrease 0 remain the same

(1) Non-responses excluded.

There is a strong preference for recruiting full time employees in the Managerial and Natural Science groups. In contrast, retraining is relatively more frequently mentioned in reference to positions requiring less formal education. This reflects the relatively higher cost of retraining executives and engineers for new positions compared with retraining costs for machinists, etc.

5.4 Technology Impact on Skill Levels and Job Content

Respondents were asked to rank the expected impact of new technology on selected occupations for:

- skills required,
- time required to achieve proficiency, and
- knowledge of their firms' operations

Their responses are shown on Table 14.

In most cases the introduction of new technology is expected to require that personnel will need to acquire more skills and become more knowledgeable regarding firm operations and will require somewhat more time to become proficient in their occupations than in the past.

Skill requirements are increasing for Managerial and Related and most occupations in the Natural Sciences, Engineering and Mathematics groups, but workers who engage in welding and metal shaping may well need to achieve a lower skill level than previously required. Thus in the Machining category, foremen and some machinists may face the need to upgrade their skills in order to be able to supervise a highly automated shop floor. Foremen, tool and die makers and machinists are expected to take at least as long or longer than before to become proficient in their work.

Employees involved in Fabricating are unlikely to find changes in the skill levels demanded of them, but training time is expected to rise. Such employees may be working with carbon fiber composites and exotic alloys instead of more traditional steel and using relatively sophisticated machinery in the process of assembling parts or repairing and modifying finished products.

A look at the occupation of draughtsmen illustrates the impact of computers on design (and, by extension, manufacture). Although an increase in skill level is taking place in this field, the time requirements for becoming qualified are dropping.

5.5 Training Costs and New Technology

The Aircraft and Aircraft Parts Industry has been spending about 4 to 5 percent of their labour costs on employee training in the past. Firms expect to increase training outlays in the 1985-1995 period to about 7 percent to ensure proper training to operate the new technology being introduced. Approximately 55 percent of the training costs currently are estimated to be related to new technology, compared to 50 percent in 1981. The firms expect that by 1990 through 1995, about 65 percent of all training costs will be related to new technology.

6.0 LABOUR RELATIONS ENVIRONMENT

This chapter discusses the labour relations environment in the industry.

6.1 Industrial Relations Environment: Historical

There are 10,197 unionized employees in the aircraft and aircraft parts industry representing 80 percent of total employees. The United Auto Workers and Machinists account for 73.1 and 17.9 percent respectively of all unionized workers, and five other unions ranked in decreasing order of employee representation make up the balance, as follows:

- United Steelworkers
- Independent Locals
- Guards Association
- Plant Guard Workers
- Canadian Operating Engineers

The major employers with union agreements are cited in Table 15.

6.2 Trends in Unionization

The survey portrays an industry in which large firms are fully unionized, medium sized firms only partially and small firms largely unorganized. See Table 16, page 49.

Firms expect unionization levels to drop in large firms, but only very gradually. By 1995, they expect that 75 percent of employees will still be union members. The very slight shift in occupational structure in the direction of managerial and natural science and engineering employees will help to produce this result, but the bulk of the decrease will be due to the relatively strong growth in small firms.

TABLE 15

INDUSTRIAL RELATIONS: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

UNION	NUMBER OF MEMBERS	MAJOR EMPLOYER*	LOCATION	TECHNICAL CHANGE CLAUSE IN AGREEMENT
UNITED AUTO WORKERS	3,966	McDonnell Douglas Canada Ltd.	Mississauga	Training, Transfer Arrangements
	507		Mississauga	Advance Notice, Consultation, Training
	1,731	DeHavilland Aircraft of Canada	Toronto & Malton	Advance Notice, Training, Joint Automation Committee, Transfer Arrangements, Arbitration
	582		Toronto	Advance Notice, Training, Joint Automation Committee
	358	Spar Aerospace Limited	Toronto	Advance Notice, Training, Joint Automation Committee
MACHINISTS	505	Fleet Industries, a Division of Ronyx	Fort Erie	None
	392	Hawker Siddeley Canada Inc., Orenda Division	Malton	Advance Notice, Consultation, Training
	290	Boeing of Canada Ltd.	Arnprior	None
UNITED STEELWORKERS	370	Walbar of Canada Inc.		None

* Employer with a union agreement covering 200 employees or more.
The union agreements above represent 85 percent of unionized employees.

SOURCE: Collective Bargaining Agreement Systems, Ontario Ministry of Labour.

Results of Question 14a,b,c

TABLE 16: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

SIC 321

Union Representation in Firms

Firms by Employment Size	Percent of Firms With Union Representation (1)	Of Firms with Union, Percent of Employment Unionized (1)			
		Estimate		Expected	
		1984	1985	1990	1995
Small (50-99)	0	-	-	-	-
Medium (100-499)	67	65	66	65	64
Large (500+)	100	80	81	78	76
Total Firms	66	79	80	77	75

(1) Rounded to the nearest 1%.

Results of Question 15d,e

TABLE 17: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

SIC 321

Unions and Technology Change

Firms by Employment Size	Percent of Contracts with a Technology Change Clause	Percent of Technology Change Clauses Covering					
		Notice/ Disclosure	Consultation/ Participation	Joint Committee	Job Security	Seniority	Other
Medium (100-499)	50	0	0	0	100	100	0
Large (500+)	62	100	50	75	38	50	12
Total Unionized Firms	60	89	44	67	44	56	11

6.3 Technology Change Clauses

Large firms with their strong unionization have engaged most thoroughly in drawing up technology change clauses which cover most concerns of the work force (see Table 17).

Medium sized firms have a lower incidence of union representation and therefore, technology change clauses. Job security and seniority appears to be well covered by these firms.

6.4 Management's Perception of their Unions' Position on New Technology

Firm executives believe that union officials either accept or are coming to accept the introduction of new technology as being essential to the firms' health. This can be said for an estimated 75 percent of the union representatives from large firms as well as for some union representatives in medium sized firms. These representatives of the work force have expressed several concerns to management about technical innovation. These concerns are spread fairly evenly over the subjects of job security, especially for older employees, training for those made redundant by new technology and the union's role in sharing benefits and controlling introduction of new machinery and equipment. Some of these concerns have been written formally into technology change contracts.

6.5 Nature of Worker Involvement in the Process of Technological Change

Firms were asked whether they had a formal mechanism for worker participation in setting production and/or sales targets,

improving productivity and/or quality, and adopting new technology.

- Approximately 22 percent of the firms have a mechanism for worker involvement in setting production and/or sales targets at some level in the organization.

- 52 percent of the firms have a mechanism for worker involvement for improving productivity and/or quality. This rises to 60 percent for large firms.

- 42 percent of firms have a mechanism for worker involvement for adopting new technology.

6.6 Views on Involving Workers in Decisions on Adopting New Technology

Both management and union leaders were asked about the degree of worker involvement that they thought was appropriate in deciding whether to adopt a new type of technology.

As outlined in the previous section, management views vary widely. All favour keeping workers informed and most say that they consult with their employees on the details of new technology introduction. Several firms have taken steps to ensure that planned changes are explained in advance and most offer training of a formal or informal nature to their workers, including those displaced.

However, union representatives describe a much more limited process of consultation than do executives of firms. Some assert that existing technology joint committees never meet and that information transfer is often limited. The union leadership describes itself as in favour of, or not opposed to, technical change. They realize, they say, that to oppose change in order

to preserve individual jobs is to risk a loss of competitiveness. The chief concerns in new technological decisions are that those displaced be compensated properly and, wherever possible, offered retraining with a view to continuing employment. Some express the feeling that their ability to knowledgeably make technology change decisions is limited, but return to the topic of worker protection measures.

Results of Question 18

TABLE 18: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

SIC 321

Planning for Technological Change

Firms by Employment Size	Strategic Plan	Human Resource Plan		Capital Investment Plan		Perceived Integration Between Capital and Human Plans (1)
	Percent of Firms With Plan	Percent of Firms With Plan	Length of Planning Horizon	Percent of Firms With Plan	Length of Planning Horizon	
Small (50-99)	0	0	-	0	-	-
Medium (100-499)	0	50	4 years	50	3 years	1.0
Large (500+)	100	60	4 years	80	4 years	3.0
Total Firms	56	41	4 years	52	4 years	2.7

1. Using a scale of 1 to 5; 1 represents "Not at all integrated" and 5 "Highly integrated".

7.0 Planning For Technological Change

This chapter reports the survey results of the questions regarding planning for technological change. The results are summarized in Table 18.

In general, firms with 500 or more employees are more likely to have plans and longer planning horizons than do the smaller or medium sized firms. The small firms reported no formal planning procedure. In contrast, the large firms reported having a fairly integrated planning procedure linking the strategic plan with both the human resource capital investment plans with a time horizon of three years. While the medium sized firms reported not having a strategic plan, about 50 percent of the firms did have human resource and capital investment plans which were not very highly integrated.

PART IV - APPENDICES

Part IV of this report presents the appendices referred to in Parts I and II.

These appendices are:

Appendix	Title	Reference
A	Firm Employment Size Categories Used in the Survey of the Aircraft and Aircraft Parts	Part I
B	Questionnaire and Responses by Question	Part I Part III
C	Reliability of the Sample	Part I
D	Historical Tables	Part II

APPENDIX A

FIRM EMPLOYMENT SIZE CATEGORIES USED IN THE SURVEY OF THE AIRCRAFT AND AIRCRAFT PARTS INDUSTRY

FIRM EMPLOYMENT SIZE CATEGORIES USED IN THE SURVEY OF THE AIRCRAFT AND AIRCRAFT PARTS INDUSTRY

Size Categories Used to Stratify the Sample Frame	Size Categories Used to Weight and Report Survey Results	
Number of Employees		Number of Employees
50 - 99	Small	50 - 99
100 - 199	Medium	100 - 499
200 - 499		
500 - 999	Large	500 or more
1000 - 1499		
1500 - 2499		
2500 - 4999		
5000 or more		

QUESTIONNAIRE

AND

RESPONSES BY QUESTION

ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

AIRCRAFT & AIRCRAFT PARTS
(SIC 321)
QUESTIONNAIRE

Currie, Coopers & Lybrand
Management Consultants

INTRODUCTION

Thank you for agreeing to participate in the study. It is being carried out for the Ontario Task Force on Employment and New Technology, a joint labour-management group. Their mandate is to examine the extent and nature of employment change likely to result from the introduction and application of new technology in Ontario over the next ten years.

You Will Receive The Survey Results
As a participant, you will receive a report on the survey results for your industry.

All Responses Will Be Confidential
All responses will be held in strictest confidence. Responses will be analysed and used only at an industry-wide level.

Both Organized Labour and Management Are Being Surveyed
Management and organized labour participants, in the case of unionized firms, will both receive a questionnaire. We realize that labour participants may not be able to answer some of the questions. In particular, they may find difficulty in answering questions: 10, 11, 12, 13 and 17.

Participants May Want to Consult Key Resource People in Responding
The questionnaire is not necessarily meant to be completed by only one respondent. It may be appropriate and even desirable for survey participants to consult other key resource people in their firm before responding to the questionnaire. Respondents should indicate on the Participant Information (p.4), the "principle respondent" and "other respondents" as well as the Section(s) of the questionnaire to which they contributed.

You Will Save Time if Information is Filled in Before the Interview
A number of questions relate to your firm's past or present workforce and future plans. We are requesting management respondents to provide accurate information from their organization's records in advance of the interview. This step will reduce the time needed for the actual interview and also make it more meaningful. The Participant Information (p.4) and the following questions should be filled in prior to the management interview: 3, 6 to 13 inclusive, 15 and 17.

Group Interviews Are Possible
In some cases the principle respondent may want to arrange a group interview between himself, key resource people and our consultant. We would welcome such an arrangement. This option is open to either management or labour participants.

You May Wish to Complete the Entire Questionnaire Before the Interview
The entire questionnaire could be completed in advance of the interview. If this is convenient, please do so. We would, however, still wish to spend a half-hour with you to review your responses.

Your "Best" Estimate
Where estimates are required, we are asking respondents to provide us with their "best estimate". Estimating future trends is difficult. Our premise is that an expert inside the organization is in the best position to make them, based on his or her knowledge of the firm's future direction.

EXHIBIT A

SELECTED OCCUPATIONS: AIRCRAFT & AIRCRAFT PARTS, SIC 321

MANAGERIAL, ADMINISTRATIVE & RELATED (includes senior and middle management and administrative support functions such as personnel officers, financial officers).

NATURAL SCIENCE, ENGINEERING & MATHEMATICS

Engineers.
Draughtsmen.
Engineering Technicians & Technologists.
Systems Analysts & Computer Programmers.

PROCESSING (includes materials processing occupations such as in metal processing: refining, smelting, heat treating, rolling, moulding, casting, extruding, plating, testing and inspecting).

MACHINING

Foremen.
Tool & Die Making.
Machinist & Machine-Tool Set-Up.
Metal Shaping and Forming, Except Machinery.
Welding/Soldering.

FABRICATING, ASSEMBLING & REPAIRING

Aircraft Fabricating & Assembling.
Inspecting & Testing.
Electrical Equipment: Installing & Repairing.
Aircraft Mechanics.

MATERIAL HANDLING & RELATED (includes such occupations as hoisting, material handling equipment operators and packaging).

The Study is Focusing on Selected Occupations

The Task Force for your industry is focusing on chosen major occupational groups and selected occupations within these major groups. These are listed in Exhibit A. The job titles and definitions being used are from the "Canadian Classification and Dictionary of Occupations, 1971" (CCDO). The CCDO is a universal system of job titles and descriptions. Our consultants are available to assist you or your staff in clarifying which of your firm's positions should be considered in the CCDO titles listed in Exhibit A.

Please Call If You Have Any Enquiries

Should you or your staff require any assistance, please call Sandra Skivsky of our firm or the consultant who will be interviewing you, at 366-1921.

Your Participation Is Appreciated

While we appreciate that your participation in the survey puts a demand on your time and organization, we would emphasize that your contribution will have an important impact on the results of this project.

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PARTICIPANT INFORMATION

COMPANY NAME: _____

UNION NAME (If appropriate): _____

AFFILIATED ORGANIZATIONS: _____

MAIN ADDRESS: _____

TELEPHONE NUMBER: ( ) _____

BRIEF DESCRIPTION OF OPERATION IN ONTARIO

Divisions/Branches/Affiliates	Products/Services

SURVEY PARTICIPANTS

Names	Position	Number of Years With Company	Number of Years With Industry	Check (✓) Sections Answered II	III	IV	V	VI	VII
				☐	☐	☐	☐	☐	☐
(principal respondent)				☐	☐	☐	☐	☐	☐
(other respondents)				☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐
				☐	☐	☐	☐	☐	☐

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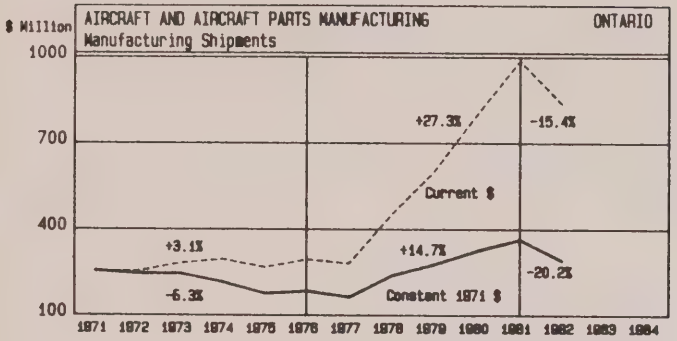
CHART 1

INDUSTRY-WIDE MANUFACTURING SHIPMENTS IN ONTARIO*



* Source: Statistics Canada, Manufacturing Industries of Canada: National and Provincial Areas, Cat. No. 31-203. Graph, constant dollar calculation and rates of change by Economics Practice, Currie, Coopers & Lybrand.

(SIC 321)

1. INDUSTRY-WIDE MANUFACTURING SHIPMENTS IN ONTARIO

Chart 1, opposite, illustrates manufacturing shipments for the Aircraft & Aircraft Parts Industry in ONTARIO in current dollars (dotted line) and in constant dollars (current dollars adjusted for price changes-solid line).

The rates shown for the first three time periods listed below are expressed in annual compound rates of change (in constant dollars).

Using these rates as a guide, please estimate the annual compound rates of change (in constant dollars) of your industry's value of manufacturing shipments in Ontario for the next five periods listed.

Manufacturing Shipments in Ontario	Annual Compound Rate of Change (in constant dollars)
1971 to 1976	-6.3 %
1976 to 1981	+14.7 %
1981 to 1982	-20.2 %
	Your Estimates (Indicate if + or -)
1982 to 1983?	____ %
1983 to 1984?	____ %
1984 to 1985?	____ %
1985 to 1990?	____ %
1991 to 1995?	____ %

(SIC 321)

2. INDUSTRY-WIDE OUTLOOK - EMPLOYMENT IN ONTARIO

The table below indicates total employment and annual compound rates of change for employment in the Aircraft & Aircraft Parts Industry in ONTARIO between 1971 and 1982. (Statistics Canada, Cat. No. 31-203).

Would you please indicate your estimates for the five following periods listed below (i.e., 1983-1995). Provide your estimates in actual numbers or in annual compound rates of change, **whichever is easier.**

For your information, total employment covers full-time, part-time, temporary, casual and contract - i.e., total "head count".

Total Employment in Ontario		Annual Compound Rates of Change	
1971	11,091		
1981	15,800	1971-1981	+3.6 %
1982	12,732	1981-1982	-19.4 %

Your Estimates:

			(Indicate if + or -)
1983?	_____ OR	1982-1983?	___ %
1984?	_____ OR	1983-1984?	___ %
1985?	_____ OR	1984-1985?	___ %
1990?	_____ OR	1985-1990?	___ %
1995?	_____ OR	1990-1995?	___ %

(SIC 321)

3. FIRM'S ADOPTION OF TECHNOLOGIES

The following questions refer to new technologies your firm has already or may adopt over the next ten years in ONTARIO.

3a. Please indicate the technologies that have already been adopted by your firm. Record your answer on Chart 3, opposite, under column 3a.

3b. Please indicate the technologies that will probably be adopted by your firm between **1985** and **1990**. Record your answer on Chart 3, under column 3b. It may be appropriate to check more than one time period.

3c. Please indicate the technologies that will probably be adopted by your firm between **1991** and **1995**. Record your answer on Chart 3, under column 3c. It may be appropriate to check more than one time period.

(SIC 321)

CHART 3

TECHNOLOGIES ADOPTED OR TO BE ADOPTED BY THE FIRM

	3a ADOPTED IN 1984 OR BEFORE	3b WILL BE ADOPTED BETWEEN 1985-1990?	3c WILL BE ADOPTED BETWEEN 1991-1995?
1. DESIGN TECHNOLOGIES			
Computer-Aided Design (CAD)	☐	☐	☐
Computer-Aided Engineering (CAE)	☐	☐	☐
CAD/CAM Integration	☐	☐	☐
Any Others? _____	☐	☐	☐
_____	☐	☐	☐
2. MANUFACTURING PLANNING & CONTROL SYSTEMS			
Computerized Financial Systems	☐	☐	☐
Computerized Order Entry/Inventory Control	☐	☐	☐
Computer-Aided Process Planning	☐	☐	☐
Manufacturing Resource Planning Systems (MRP)	☐	☐	☐
Automated Shop Floor Data Collection	☐	☐	☐
Computerized Decision Support Systems	☐	☐	☐
Computerized Maintenance Planning & Control	☐	☐	☐
Any Others? _____	☐	☐	☐
_____	☐	☐	☐
3. MANUFACTURING PROCESS TECHNOLOGIES			
"Fly-by-Wire" Avionics	☐	☐	☐
Carbon Fiber Composites/Exotic Alloys	☐	☐	☐
Numerically Controlled Machines (NC)	☐	☐	☐
Computer Controlled CN Machines (CNC)	☐	☐	☐
CAD Directed CNC	☐	☐	☐
Computerized Process Control Systems	☐	☐	☐
Computer-Aided Inspection & Testing	☐	☐	☐
Robotic Applications	☐	☐	☐
Flexible Manufacturing Technologies	☐	☐	☐
Computer Integrated Manufacturing (CIM)	☐	☐	☐
Any Others? _____	☐	☐	☐
_____	☐	☐	☐
4. MATERIALS HANDLING TECHNOLOGIES			
Automatic Bulk Handlers/Feeder Systems	☐	☐	☐
Automated Conveyor/Vehicle Systems	☐	☐	☐
Automated Storage & Retrieval	☐	☐	☐
Computer Controlled Conveyor/Vehicles	☐	☐	☐
Automated Warehouse	☐	☐	☐
Any Others? _____	☐	☐	☐
_____	☐	☐	☐
5. TELECOMMUNICATIONS TECHNOLOGIES			
Facsimile (FAX) Link: HO/Plants	☐	☐	☐
Computer Link: HO/Plant(s)	☐	☐	☐
Computer Link: Suppliers/Customers	☐	☐	☐
Any Others? _____	☐	☐	☐
_____			
6. OTHER TECHNOLOGIES			
_____	☐	☐	☐
_____	☐	☐	☐
HAVE/WILL NOT ADOPT ANY NEW TECHNOLOGIES IN THIS PERIOD	☐	☐	☐

(SIC 321)

4. FORCES DRIVING THE FIRM'S NEED FOR NEW TECHNOLOGIES OVER THE NEXT 10 YEARS

4a. What is the **single most important driving factor** in your firm's internal or external environment which could accelerate your **firm's need to adopt** these new technologies over the next 10 years in ONTARIO?

_____
_____
_____

4b. What is the **second most important factor** likely to accelerate your firm's need to adopt these new technologies?

_____
_____
_____

4c. And what is the **third most important** factor?

_____
_____
_____

5. FACTORS AFFECTING THE FIRM'S RATE OF TECHNOLOGY ADOPTION OVER THE NEXT 10 YEARS

5a. What is the **single most important factor** in your firm's internal or external environment that could slow down the speed at which your firm will adopt these new technologies over the next 10 years in ONTARIO?

_____
_____
_____

5b. What is the **second most important** factor that could slow down your firm's adoption of these new technologies?

_____
_____
_____

5c. And what is the **third** most important factor?

_____
_____
_____

6. IMPACT OF TECHNOLOGY ON OCCUPATIONS OVER THE NEXT 10 YEARS

The following questions attempt to determine impacts on specific occupations you expect to be caused by the adoption of new technologies in your firm over the next 10 years in ONTARIO.

6a. Please indicate the **occupations** in which your firm is likely to have an **oversupply of people** over the next 10 years as a result of the adoption of these new technologies. Record your answer on Chart 6, opposite, under column 6A.

6b. Please indicate the **occupations** in which you expect your firm will have **a shortage of the skills** required to cope with these new technologies. Record your answer on Chart 6, under column 6B.

(SIC 321)

CHART 6

IMPACT OF TECHNOLOGIES ON SELECTED OCCUPATIONS
IN YOUR FIRM OVER THE NEXT 10 YEARS

	6a OCCUPATIONS WITH AN OVERSUPPLY OF SKILLS	6b OCCUPATIONS WITH A SHORTAGE OF THE REQUIRED SKILLS
MANAGERIAL, ADMINISTRATIVE & RELATED	☐	☐
NATURAL SCIENCE, ENGINEERING & MATHEMATICS		
• Engineers	☐	☐
• Draughtsmen	☐	☐
• Engineering Technicians & Technologists	☐	☐
• Systems Analysts & Computer Programmers	☐	☐
PROCESSING	☐	☐
MACHINING		
• Foremen	☐	☐
• Tool & Die Making	☐	☐
• Machinist & Machine-Tool Set-Up	☐	☐
• Metal Shaping and Forming, Except Machinery	☐	☐
• Welding/Soldering	☐	☐
FABRICATING, ASSEMBLING & REPAIRING		
• Aircraft Fabricating & Assembling	☐	☐
• Inspecting & Testing	☐	☐
• Electrical Equipment, Installing & Repairing	☐	☐
• Aircraft Mechanics	☐	☐
MATERIAL HANDLING AND RELATED	☐	☐
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?		
_____	☐	☐
_____	☐	☐
_____	☐	☐

7. ACTIONS TO DEAL WITH OVERSUPPLY OF SKILLS IN FIRM OVER NEXT 10 YEARS

The following questions relate to the actions your firm will likely take to deal with the oversupply of people in your firm resulting from the adoption of these new technologies in ONTARIO.

7a. For each occupation with a potential oversupply of skills (as you indicated in Q.6a), please identify the **steps** your firm will likely take that will **affect the largest number of people** in that occupation. Record your answers on Chart 7, opposite, under column 7a.

In answering this and the following question, please consider the possible actions listed below as well as any other possible action not in the list but that your firm is likely to take.

Possible Actions

- Attrition
- Early Retirement
- Layoffs
- Relocation (geographic)
- Shorter hours/work week
- Job sharing
- Change from full-time to part-time
- Retraining
- Lateral transfer
- Upgrading
- Downgrading
- Etc. etc.,

7b. Again, for each of these occupations, identify the step your firm may take that will affect the **second largest number of people** in that occupation. Record on Chart 7, under column 7b.

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CHART 7

STEPS FIRM WILL LIKELY TAKE
TO DEAL WITH OVERSUPPLY OF SKILLS OVER NEXT 10 YEARS

OCCUPATIONS	7a STEPS THAT WILL AFFECT THE LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION	7b STEPS THAT WILL AFFECT THE 2ND LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION
MANAGERIAL, ADMINISTRATIVE & RELATED		
NATURAL SCIENCE, ENGINEERING & MATHEMATICS		
• Engineers		
• Draughtsmen		
• Engineering Technicians & Technologists		
• Systems Analysts & Computer Programmers		
PROCESSING		
MACHINING		
• Foremen		
• Tool & Die Making		
• Machinist & Machine-Tool Set-Up		
• Metal Shaping and Forming, Except Machinery		
• Welding/Soldering		
FABRICATING, ASSEMBLING & REPAIRING		
• Aircraft Fabricating & Assembling		
• Inspecting & Testing		
• Electrical Equipment, Installing & Repairing		
• Aircraft Mechanics		
MATERIAL HANDLING AND RELATED		
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?		

(SIC 321)

8. STEPS TO ACQUIRE THE NEW SKILL REQUIREMENTS OVER THE NEXT 10 YEARS

The following questions are intended to identify the most likely steps your firm may take to acquire the new skill requirements associated with the new technologies over the next 10 years in ONTARIO.

8a. Please indicate, for each occupation with a potential shortage of the new skill requirements (as you indicated in Q6b), the **step** your firm will likely take that will **affect the largest number of people** in that occupation. Record your answers on Chart 8, column 8a.

Please consider the possible actions listed below as well as any other action (not listed) that your firm is likely to take.

Likely Steps

- Retraining
- Relocation
- Upgrading
- Increased overtime of firm's skilled people
- Recruiting full-time skilled people
- Recruiting part-time skilled people
- Contracting work out
- Etc., etc...

8b. Please indicate, for each occupation, the **step** your firm may take that will affect the **second largest number of people** in that occupation. Record your answers in column 8b.

(SIC 321)

CHART 8

STEPS FIRM WILL TAKE
OVER NEXT 10 YEARS TO ACQUIRE THE NEW SKILL REQUIREMENTS

OCCUPATIONS	8a STEP WHICH WILL AFFECT THE LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION	8b STEP WHICH WILL AFFECT THE 2ND LARGEST NUMBER OF PEOPLE IN THIS OCCUPATION
MANAGERIAL, ADMINISTRATIVE & RELATED		
NATURAL SCIENCE, ENGINEERING & MATHEMATICS		
• Engineers		
• Draughtsmen		
• Engineering Technicians & Technologists		
• Systems Analysts & Computer Programmers		
PROCESSING		
MACHINING		
• Foremen		
• Tool & Die Making		
• Machinist & Machine-Tool Set-Up		
• Metal Shaping and Forming, Except Machinery		
• Welding/Soldering		
FABRICATING, ASSEMBLING & REPAIRING		
• Aircraft Fabricating & Assembling		
• Inspecting & Testing		
• Electrical Equipment, Installing & Repairing		
• Aircraft Mechanics		
MATERIAL HANDLING AND RELATED		
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?		
_____		
_____		
_____		

(SIC 321)

9. NATURE OF IMPACT ON SKILLS AND JOB CONTENT OVER THE NEXT TEN YEARS

The following questions are meant to identify the nature of the impact on selected occupations in ONTARIO.

9a. For selected occupations in your firm, please indicate how the new technologies will affect each in their daily work. That is, will their daily work require greater skill (+), less skill (-), or about the same skill (0) as they currently require. Record your answers on Chart 9, opposite, under Column 9a.

9b. Please indicate whether the new skills they require will demand more time (+), less time (-), or about the same time (0) to achieve the proficiency that they will need. Record your answers on Chart 9, column 9b.

9c. Please indicate whether, in using these new technologies, these occupations will require more knowledge (+) of the company's operations, less knowledge (-), or about the same (0) amount of knowledge as is currently required to perform their daily tasks. Record your answers on Chart 9, under 9c.

(SIC 321)

CHART 9

IMPACT OF TECHNOLOGY ON SKILL LEVELS AND JOB CONTENT

	9a SKILLS REQUIRED (+, -, 0)	9b TIME TO ACHIEVE PROFICIENCY (+, -, 0)	9c KNOWLEDGE OF COMPANY'S OPERATIONS (+, -, 0)	COMMENTS
MANAGERIAL, ADMINISTRATIVE & RELATED	___	___	___	_____
NATURAL SCIENCE, ENGINEERING & MATHEMATICS				
• Engineers	___	___	___	_____
• Draughtsmen	___	___	___	_____
• Engineering Technicians & Technologists	___	___	___	_____
• Systems Analysts & Computer Programmers	___	___	___	_____
PROCESSING	___	___	___	_____
MACHINING				
• Foremen	___	___	___	_____
• Tool & Die Making	___	___	___	_____
• Machinist & Machine-Tool Set-Up	___	___	___	_____
• Metal Shaping and Forming, Except Machinery	___	___	___	_____
• Welding/Soldering	___	___	___	_____
FABRICATING, ASSEMBLING & REPAIRING				
• Aircraft Fabricating & Assembling	___	___	___	_____
• Inspecting & Testing	___	___	___	_____
• Electrical Equipment, Installing & Repairing	___	___	___	_____
• Aircraft Mechanics	___	___	___	_____
MATERIAL HANDLING AND RELATED	___	___	___	_____
ANY OTHER OCCUPATIONS SIGNIFICANTLY AFFECTED? WHICH ONES?				
_____	___	___	___	_____
_____	___	___	___	_____
_____	___	___	___	_____

10. TRAINING/RETRAINING

These questions are about the current and future importance of **training and retraining** in your organization.

10a. Please indicate what were your firm's total training costs as a percent of total labour costs in **1981**. Record your answer on Chart 10, line 10a.

Training costs include the costs of internally or externally provided training programs, classroom and on-the-job workshops, vouchers or tuition credits, provided by your firm, which are intended to train employees to perform their jobs or to retrain employees to assume new or alternate jobs. Labour costs include all wages, salaries and benefits. (e.g., $\frac{\text{Total Training Costs}}{\text{Total Labour Costs}} \times 100 = 1.0\%$)

10b. Please indicate what your firm's total training costs as a percent of total labour costs will be in **1984** (to year end). Record your answer on line 10b.

10c. What do you estimate for **1985**, (line 10c)?

10d. What do you estimate it will be in **1990**, (line 10d)?

10e. What do you estimate it will be in **1995**, (line 10e)?

10f. For each year on Chart 10, (line 10a to 10e), please indicate what percent of total training costs in each year have or will go towards training people to adapt to the new technologies.

(SIC 321)

CHART 10

TRAINING COSTS OF FIRM

			As a Percent of Total Labour Costs	Percent of Total Training Costs Directly Related to New Technologies
10a.	1981?	Actual	___%	___%
10b.	1984?	Estimate	___%	___%
10c.	1985?	Estimate	___%	___%
10d.	1990?	Estimate	___%	___%
10e.	1995?	Estimate	___%	___%

(SIC 321)

11. FIRM'S EMPLOYMENT TRENDS

In this section, we would like to determine how the firm's employment levels in ONTARIO are likely to change over the next 10 years.

11a. To begin, considering all possible factors in your firm's internal and external environment, what is the **single most important factor** which will have an impact on your firm's level of employment in ONTARIO over the next 10 years? _____

_____

11b. The **second most important factor**?_____

_____

11c. The **third most important factor**?_____

_____

11d. Please indicate **total employees** (includes full-time, temporary, contract, casual, seasonal and part-time employment) in your organization in ONTARIO for **1971, 1981 and 1984** from your employment records. Record your answers on Chart 11, column 11d.

Please estimate future total employment in your organization in ONTARIO for **1985, 1990 and 1995.**

11e. Please indicate the **percent** of your total employment in ONTARIO that are **part-time** employees (i.e., less than normal full work week), for **1981 and 1984.** Record your answers on Chart 11, column 11e.

Also in column 11e, please estimate part-time employees as a percent of total employees in ONTARIO for **1985, 1990 and 1995.**

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11f. Please translate your total ONTARIO employment (include full-time, part-time, casual, temporary, seasonal) into a full-time equivalent (**F.T.E.**) figure for your firm for **1981** and **1984** in column 11f.

Also in column 11f, please estimate total employment in terms of a full-time equivalent (F.T.E.) for **1985, 1990** and **1995.**

By **F.T.E.** we mean a normal, full, work week for a normal, full year. F.T.E. can be measured in a variety of ways depending on whatever is normal for your firm or industry. For example, if expressed in hours of work per year one FTE might range from 1750 to 2000 hours of work a year depending on the length of the normal work week (e.g., 35 hours/week x 50 weeks = 1750 hours, 40 hours/week x 50 weeks = 2000 hours.)

CHART 11

FIRM'S EMPLOYMENT TRENDS IN ONTARIO

	11d TOTAL EMPLOYMENT IN ONTARIO	11e PART-TIME EMPLOYEES AS A % OF TOTAL EMPLOYMENT	11f TOTAL EMPLOYMENT IN FULL-TIME EQUIVALENT (F.T.E.)
Actual Figures			
1971?	_____		
1981?	_____	_____ %	_____ FTE
1984?	_____	_____ %	_____ FTE
Your Estimates			
1985?	_____	_____ %	_____ FTE
1990?	_____	_____ %	_____ FTE
1995?	_____	_____ %	_____ FTE

(SIC 321)

12. CHANGES IN EMPLOYMENT STRUCTURE

This section is intended to measure the changes in the employment structure of your firm in ONTARIO between 1981 and 1995.

12a. Please indicate the actual percentage share of each occupation listed as a percent of your firm's total employment in ONTARIO in 1981. Record your answer on Chart 12, column 12a.

12b. Please indicate the actual percentage share of each selected occupation listed as a percent of your firm's total employment in ONTARIO in 1984. Record your answer in column 12b.

12c. Please estimate the same for each selected occupation in 1985. Record in column 12c.

12d. Please estimate the same for each selected occupation in 1990. Record in column 12d.

12e. Please estimate the same for each selected occupation in 1995. Record in column 12e.

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	OCCUPATIONS AS A PERCENT OF TOTAL EMPLOYMENT OF THE FIRM IN ONTARIO					
	12a Actual 1981	12b Actual 1984	12c Estimate 1985	12d Estimate 1990	12e Estimate 1995	
	%	%	%	%	%	
MANAGERIAL, ADMINISTRATIVE, & RELATED	☐	☐	☐	☐	☐	1*
NATURAL SCIENCE, ENGINEERING & MATHEMATICS	☐	☐	☐	☐	☐	2*
• Engineers	___	___	___	___	___	
• Draughtsmen	___	___	___	___	___	
• Engineering Technicians & Technologists	___	___	___	___	___	
• Systems Analysts & Computer Programmers	___	___	___	___	___	
• All Other Science & Mathematics (not listed above)	___	___	___	___	___	
PROCESSING	☐	☐	☐	☐	☐	3*
MACHINING	☐	☐	☐	☐	☐	4*
• Foremen	___	___	___	___	___	
• Tool & Die Making	___	___	___	___	___	
• Machinist & Machine-Tool Set-Up	___	___	___	___	___	
• Metal Shaping and Forming, Except Machinery	___	___	___	___	___	
• Welding/Soldering	___	___	___	___	___	
• All Other Machining Occupations (not listed above)	___	___	___	___	___	
FABRICATING, ASSEMBLING & REPAIRING	☐	☐	☐	☐	☐	5*
• Aircraft Fabricating & Assembling	___	___	___	___	___	
• Inspecting & Testing	___	___	___	___	___	
• Electrical Equipment, Installing & Repairing	___	___	___	___	___	
• Aircraft Mechanics	___	___	___	___	___	
• All Other Fabricating, Assembling, & Repair (not listed above)	___	___	___	___	___	
MATERIAL HANDLING AND RELATED	☐	☐	☐	☐	☐	6*
ALL OTHER OCCUPATIONS	☐	☐	☐	☐	☐	7*
* FIRM'S TOTAL EMPLOYMENT IN ONTARIO (1+2+3+4+5+6+7 = 100%)	100%	100%	100%	100%	100%	

(SIC 321)

13. EMPLOYMENT STRUCTURE BY SEX

The following questions refer to your firm's employment in ONTARIO **by sex** for each specific occupation listed in Chart 13.

13a. Please provide the percentage split between male and female of your employees in ONTARIO **by each occupation in 1981.** Record your answer on Chart 13, column 13a.

13b. Please provide the percentage split between male and female employees by occupation in ONTARIO **in 1984.** Record your answer in Column 13b.

(SIC 321)

CHART 13

EMPLOYMENT STRUCTURE BY SEX AND OCCUPATION IN ONTARIO

	13a 1981 EMPLOYMENT MALE	FEMALE	TOTAL	13b 1984 EMPLOYMENT MALE	FEMALE	TOTAL
MANAGERIAL, ADMINISTRATIVE & RELATED	___% +	___%	=100%	___% +	___%	=100%
NATURAL SCIENCE, ENGINEERING & MATHEMATICS						
• Engineers	___% +	___%	=100%	___% +	___%	=100%
• Draughtsmen	___% +	___%	=100%	___% +	___%	=100%
• Engineering Technicians & Technologists	___% +	___%	=100%	___% +	___%	=100%
• Systems Analysts & Computer Programmers	___% +	___%	=100%	___% +	___%	=100%
PROCESSING	___% +	___%	=100%	___% +	___%	=100%
MACHINING						
• Foremen	___% +	___%	=100%	___% +	___%	=100%
• Tool & Die Making	___% +	___%	=100%	___% +	___%	=100%
• Machinist & Machine-Tool Set-Up	___% +	___%	=100%	___% +	___%	=100%
• Metal Shaping and Forming, Except Machinery	___% +	___%	=100%	___% +	___%	=100%
• Welding/Soldering	___% +	___%	=100%	___% +	___%	=100%
FABRICATING, ASSEMBLING & REPAIRING						
• Aircraft Fabricating & Assembling	___% +	___%	=100%	___% +	___%	=100%
• Inspecting & Testing	___% +	___%	=100%	___% +	___%	=100%
• Electrical Equipment, Installing & Repairing	___% +	___%	=100%	___% +	___%	=100%
• Aircraft Mechanics	___% +	___%	=100%	___% +	___%	=100%
MATERIAL HANDLING AND RELATED	___% +	___%	=100%	___% +	___%	=100%
FIRM'S TOTAL EMPLOYEES IN ONTARIO	___% +	___%	=100%	___% +	___%	=100%

(SIC 321)

14. ORGANIZED LABOUR IN YOUR FIRM IN ONTARIO

14a. Does your firm have any workers in ONTARIO covered by a collective labour agreement(s)?

Yes ☐ No ☐ **If no, go on to Question 14c.**

14b. If yes, what percent of your firm's total employment in ONTARIO is currently **(1984)** unionized?

____%

14c. What percent of your firm's total employment in ONTARIO do you estimate will be unionized by **1985, 1990** and by **1995**?

- 1985? ____%
- 1990? ____%
- 1995? ____%

14d. If you expect an increase in the percent of total employment that will be unionized, please indicate the specific occupational groups within which you expect the increase will take place.

_____

_____

15. ORGANIZED LABOUR AND TECHNOLOGY CHANGE

If any of the employees in your firm in ONTARIO are represented by a union, please answer the following series of questions. If none of the workers in your firm in ONTARIO are unionized, please go on to Question 16, p. 22.

15a. Please indicate the name of the union(s) in your firm in ONTARIO. Record your answers on Chart 15, on line 15a.

15b. On line 15b, please indicate the number of the firm's employees in ONTARIO in each union.

15c. On line 15c, indicate the worker groups in your firm the union(s) represents.

15d. On line 15d, check ☑ if the contract(s) has a technology change clause(s).

15e. On line 15e, check ☑ if the technology change clause(s) covers any of the following:

- Notice/Disclosure
- Consultation/Participation
- Joint Technology Change Committee
- Job Security
- Seniority
- Other (please specify).

15f. On line 15f, indicate whether the clause(s) is effectively administered. If your answer is "NO", please explain your answer.

CHART 15

ORGANIZED LABOUR IN ONTARIO

	(name of union)	(name of union)	(name of union)
15a. Name of Unions in Firm			
15b. Number of Firm's Employees in Each Union			
15c. Worker Groups Represented by Each Union			
15d. Does Union(s) Contract(s) Have a Technology Change Clause(s)?			
YES	☐	☐	☐
NO	☐	☐	☐
15e. Check ☑ if Technology Change Clause(s) Includes:			
• Notice/Disclosure	☐	☐	☐
• Consultation/Participation	☐	☐	☐
• Joint Technology Change Committee	☐	☐	☐
• Job Security	☐	☐	☐
• Seniority	☐	☐	☐
• Other _____ (specify)	☐	☐	☐
15f. Is the Clause Effectively Administered?			
YES	☐	☐	☐
NO	☐	☐	☐
If 'NO', explain			

(SIC 321)

15g. In general, what has been the union's position on the adoption of new technologies in your firm? Please explain.

_____

_____

_____

_____

_____

(SIC 321)

16. THE NATURE OF WORKER INVOLVEMENT IN THE PROCESS OF TECHNOLOGY ADOPTION

The following questions are on the nature of the **relationship between workers and management** in your firm as decisions are made on the adoption of new technology.

16a. Does your firm have a formal mechanism for worker participation in any of the following? Please Check ☑ Yes or No

	YES	NO
• Setting production and/or sales targets:		
- at company level?	☐	☐
- at division/plant level?	☐	☐
- at department/area level?	☐	☐
- at working group level?	☐	☐
• Improving productivity/quality?	☐	☐
• Adoption of new technology?	☐	☐

16b. In your opinion, to what extent and how should management involve workers in decisions regarding the adoption of new technologies? Please comment.

_____

_____

_____

_____

_____

_____

(SIC 321)

17. FUTURE CAPITAL INVESTMENTS

17a. Please indicate how much, **in today's dollars**, your firm plans to spend on **construction of structures and buildings** in ONTARIO over the period **1985 to 1990** and over the period **1991 to 1995**. Record your answer on Chart 17, column 17a.

17b. What percent of this spending can be directly attributed to the adoption of **new technologies**? Record under column 17b.

17c. Would you indicate how much, **in today's dollars**, your firm plans to spend on **machinery and equipment** over the period **1985 to 1990** and over the period **1991 to 1995** in ONTARIO. Record under column 17c.

17d. What percent of this spending on **machinery and equipment** will be for **new technologies**? Record under column 17d.

17e. Please indicate what criterion your firm will likely use to justify the financial investment in the new technologies.

Pay-back period ☐ _____ If Yes, how long?

Return on investment ☐ _____ If Yes, what rate?

Other _____ (specify) ☐ _____ Please elaborate

17f. Considering now your total capital investment in new technology over the next 10 years, what percent will be funded through internal funds and what percent will be funded through external funds?

Internal funds ____%
External funds ____%
100%

(SIC 321)

CHART 17

CAPITAL INVESTMENT PLANS

IN ONTARIO

	INVESTMENT IN STRUCTURES & BUILDINGS		INVESTMENT IN MACHINERY & EQUIPMENT	
	17a	17b	17c	17d
	IN TODAY'S DOLLARS (In Thousands $)	% DIRECTLY RELATED TO **NEW TECHNOLOGY**	IN TODAY'S DOLLARS (In Thousands $)	% FOR **NEW TECHNOLOGY**
1985 to 1990?	$_____	_____%	$_____	_____%
1991 to 1995?	$_____	_____%	$_____	_____%

(SIC 321)

18. PLANNING FOR CHANGES IN TECHNOLOGY

These questions ask about your firm's plans for adopting new technologies in ONTARIO.

18a. Does your firm currently have a long-term strategic plan?

Yes ☐ No ☐

18b. Does your firm have a plan to deal with future human resource needs?

Yes ☐ No ☐ **If no, go to Question 18d.**

18c. Up to what year has your firm planned for its human resource needs?

_____

(WRITE IN YEAR)

18d. Does your firm have a capital investment plan dealing with the adoption of new technologies?

Yes ☐ No ☐ **If no, go to Question 19. on p. 25.**

18e. Up to what year has your firm planned for its capital requirements?

_____

(WRITE IN YEAR)

18f. On a scale of 1 to 5, please indicate to what extent these two plans (capital investment and human resource plans) are integrated.

(Please circle answer)

NOT AT ALL INTEGRATED	1	2	3	4	5	HIGHLY INTEGRATED

(SIC 321)

19. Please indicate below any other comments on the issue of employment and new technology you wish to make.

_____

_____

_____

_____

_____

_____

_____

_____

THANK YOU FOR YOUR PARTICIPATION

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AIRCRAFT AND AIRCRAFT PARTS INDUSTRY

Number of Firms and Unions Responding by Question

Question		Firms	Unions	Question		Firms	Unions
Question 1	1982-1983	9	3	Question 12	a,b,c,d,e	8	0
	1983-1984	9	3				
	1984-1985	9	4				
	1985-1990	9	4	Question 13		*	*
	1990-1995	9	3				
Question 2		*	*	Question 14	a	10	5
					b	10	5
					c	10	5
Question 3	a,b,c	10	5		d	2	1
Question 4	a,b,c	10	5	Question 15	a	7	5
					b	5	5
					c	*	*
Question 5	a,b,c	10	5		d	7	5
					e	5	5
					f	5	5
Question 6	a,b	9	5		g	6	5
Question 7	a	7	5	Question 16	a	10	5
	b	7	4		b	8	5
Question 8	a	9	5	Question 17	a	9	0
	b	8	5		b	9	0
					c	8	0
					d	7	0
Question 9	a	9	4		e	10	0
	b	9	4		f	12	0
	c	9	4				
				Question 18	a	9	1
Question 10	a,b,c,d,e	9	1		b	9	0
					c	4	0
Question 11	a,b,c,	9	3		d	9	1
	d	10	0		e	7	0
	e	9	0		f	5	1
	f	9	0				

* Data not used and therefore, number of responses not reported.

APPENDIX C

RELIABILITY OF THE SAMPLE

SAMPLE RELIABILITY

The sample reliability is summarized with other sample and population characteristics in "Table 1". The sample was selected as a three stage stratified random sample. The purpose of this stratification was to reduce the error variance in the measurement of organization size by increasing the homogeneity of each group of organizations within each strata.

The first stage consisted in creating two industry sectors (i.e. manufacturing and services). The second stage involved dividing up each industry sector into nine and fourteen industrial sub-classes respectively and according to Standard Industrial Classification codes (see Table 1). The third stage was to further stratify each SIC into three more homogeneous size groups:

Manufacturing Sector		Service Sector
Small	20- 99 employees	20-199 employees
Medium	100-499 employees	200-999 employees
Large	500+ employees	1,000+ employees

Exceptions to these three size groupings are as follows:

SECTOR		ORGANIZATION SIZE EXCLUSION
Manufacturing Sector		
291	Iron & Steel Mills	less than 500
321	Aircraft & Aircraft Parts	less than 50
Service Sector		
701	Banks and Trusts	less than 50
721	General and Life Insurance	less than 50
735	Insurance Brokers	less than 50
909	Federal Government	less than 500
931	Provincial Government	less than 200
951	Local Government	less than 500

Overall, the sample yields a relatively high reliability level in reflecting the employment level of those sectors surveyed. For instance, the sample for the Aircraft and Aircraft Parts Industry yields a minimum confidence level of 95 percent with an associated allowable error of 7 percent. That is, we would expect that the estimated employment level for the sector has a 95 percent chance of being within $\pm$ 7 percent of the actual employment level found in the frame. Or stated alternatively, if 100 independent random samples were drawn, in 95 of these samples we would expect to have an estimated employment level within $\pm$ 7 percent of the actual employment level found in the sample frame.

TABLE 1: SUMMARY OF MANUFACTURING INDUSTRIES

SAMPLE FRAME AND SAMPLE

		UNIVERSE		SAMPLE FRAME				SAMPLE				
Code	SIC NAME	Number of Firms	Number of[1] Employees	Min. Size Cut Off	Number of Firms	Number of[2] Employees	Share of Universe	Number of Firms	Number of Unions	Number of Employees	Reliability Level (min.)	Allowable Error
											Percent	
1	Iron and Steel Mills	17	41,603	500	7	39,900	96	3	1	21,833	90	23
4	Metal Stamping, Pressing and Coating Industry	185	17,730	20	145	17,200	97	14	3	4,507	99	5
6	Hardware, Tool and Cutlery Manufacturing	225	12,826	20	135	11,500	90	11	6	1,489	94	5
9	Miscellaneous Metal Fabricating Industries	132	12,235	20	110	12,000	98	11	6	2,694	99	5
5	Miscellaneous Machinery and Equipment Manufacturers	304	36,904	20	262	36,500	99	12	3	3,972	99	5
8	Office and Store Machinery Manufacturers	29	10,485	20	29	9,800	93	7	0	11,814	99	5
5	Communications Equipment Manufacturers	67	28,090	20	65	27,800	99	12	2	14,946	90	11
1	Aircraft and Aircraft Parts Manufacturers	22	12,732	50	17	12,000	94	10	5	11,737	95	7
5	Plastic Processing	196	19,218	20	169	18,800	98	13	4	2,400	99	5
								92	28			

Source: Census of Manufacturing, 1982, Statistics Canada, Catalogue No. 31-203.

Rounded to nearest 100.

APPENDIX D

HISTORICAL TABLES

TABLE D.1

MAJOR PRODUCTS OF THE CANADIAN

AIRCRAFT AND AIRCRAFT PARTS INDUSTRY

	VALUE OF SHIPMENTS IN 1981 ($ MILLIONS)	PERCENT OF TOTAL SHIPMENTS
Aircraft and aircraft parts manufactured	1,949.2	76.5
Modifications, conversions, servicing, overhaul and repairs to aircraft, engines etc. (value of work done)	248.8	9.8
All other products made*	351.6	13.8
TOTAL	2,549.5	100.0

* Includes adjustments and estimate for small establishments not reporting in detail.

NOTE: Details may not add to totals due to rounding.

SOURCE: Statistics Canada, Aircraft & Aircraft Parts Manufacturers Industry, Cat. No. 42-203.

TABLE D2

AIRCRAFT AND AIRCRAFT PARTS MANUFACTURING (SIC 321)
ONTARIO
1971 - 1984
Current Dollars

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	36	37	35	34	36	38	37	43	51	54	49	51		
CAPACITY UTILIZATION RATE, CANADA	70.9	76.9	91.7	89.2	84.0	88.0	90.7	88.6	88.2	66.6	61.1	52.0	58.8	
OUTPUT ($ Million)														
MANUFACTURING SHIPMENTS	253.0	254.1	282.3	296.1	268.1	295.0	280.7	451.4	601.5	800.8	987.6	835.5		
MANUFACTURING VALUE ADDED	148.6	153.6	178.9	189.9	178.2	197.7	182.8	320.6	349.1	496.5	626.7	583.3		
WAGES & SALARIES	101.5	109.7	120.9	122.6	111.2	109.2	124.2	183.0	229.7	341.7	354.0	336.8		
EMPLOYMENT (Number)														
PRODUCTION WORKERS	6,986	7,225	7,617	7,305	5,679	4,961	5,833	7,523	8,749	11,960	10,514	7,869		
ADMINISTRATIVE STAFF	4,105	3,995	4,176	4,060	3,216	3,018	2,640	3,720	3,895	5,083	5,286	4,863		
TOTAL	11,091	11,220	11,793	11,365	8,895	7,979	8,473	11,243	12,644	17,043	15,800	12,732		
CAPITAL INVESTMENT, CANADA ($ Million)														
CONSTRUCTION	3.6	2.2	4.5	1.2	2.8	2.4	4.9	12.5	15.2	45.0	34.3	51.4	5.2	12.2
MACHINERY & EQUIPMENT	6.3	6.1	10.3	12.0	11.7	9.6	11.9	22.0	38.9	66.2	62.2	69.3	51.9	82.6
TOTAL	9.9	8.3	14.8	13.2	14.5	12.0	16.8	34.5	54.1	111.2	96.5	120.7	57.1	94.8
COMPETITIVENESS														
VALUE ADDED/EMPLOYEE (Dollars)	13,397	13,690	15,170	16,707	20,036	24,782	21,572	28,514	27,607	29,130	39,663	45,817		
VALUE ADDED/$ LABOUR	1.46	1.40	1.48	1.55	1.60	1.81	1.47	1.75	1.52	1.45	1.77	1.73		
VALUE ADDED/$ LABOUR (United States)	1.70	1.73	1.98	1.98	1.94	1.91	1.93	1.88	2.05	2.08	1.91	2.02		
EXPORTS ($ Million)	172.9	289.8	261.5	237.5	151.5	183.3	210.2	297.5	457.7	704.9	729.8	716.1	512.9	
IMPORTS ($ Million)	80.9	96.7	123.2	122.8	176.7	107.2	127.0	229.3	311.3	544.5	607.5	308.4	267.2	
TRADE BALANCE ($ Million)	91.9	193.1	138.3	114.7	(25.1)	76.0	83.2	68.2	146.4	160.4	122.3	407.7	245.7	
NORMALIZED TRADE BALANCE	0.362	0.500	0.359	0.318	(0.077)	0.262	0.247	0.129	0.190	0.128	0.091	0.398	0.315	

( ) indicates deficit

NOTE: Capacity Utilization Rate shown is for Transportation Equipment.

SOURCE: Statistics Canada, MANUFACTURING INDUSTRIES OF CANADA: NATIONAL AND PROVINCIAL AREAS, Cat. No. 31-203; CAPACITY UTILIZATION RATES IN CANADIAN MANUFACTURING, Cat. No. 31-003; and External Trade Division, Special Runs. United States data supplied by Coopers & Lybrand. Calculations by Economics Practice, Currie, Coopers & Lybrand.

TABLE 03

AIRCRAFT AND AIRCRAFT PARTS MANUFACTURING (SIC 321)
ONTARIO
1971 - 1984
PER CENT CHANGE
Current Dollars

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	2.8	-5.4	-2.9	5.9	5.6	-2.6	16.2	18.6	5.9	-9.3	4.1		
OUTPUT ($ Million)													
MANUFACTURING SHIPMENTS	0.5	11.1	4.9	-9.5	10.0	-4.8	60.8	33.3	33.1	23.3	-15.4		
MANUFACTURING VALUE ADDED	3.4	16.5	6.1	-6.1	11.0	-7.6	75.4	8.9	42.2	26.2	-6.9		
WAGES & SALARIES	8.1	10.2	1.4	-9.4	-1.7	13.7	47.3	25.5	48.7	3.6	-4.9		
EMPLOYMENT (Number)													
PRODUCTION WORKERS	3.4	5.4	-4.1	-22.3	-12.6	17.6	29.0	16.3	36.7	-12.1	-25.2		
ADMINISTRATIVE STAFF	-2.7	4.5	-2.8	-20.8	-6.2	-12.5	40.9	4.7	30.5	4.0	-8.0		
TOTAL	1.2	5.1	-3.6	-21.7	-10.3	6.2	32.7	12.5	34.8	-7.3	-19.4		
CAPITAL INVESTMENT, CANADA ($ Million)													
CONSTRUCTION	-38.9	104.5	-73.3	133.3	-14.3	104.2	155.1	21.6	196.1	-23.8	49.9	-89.9	134.6
MACHINERY & EQUIPMENT	-3.2	68.9	16.5	-2.5	-17.9	24.0	84.9	76.8	70.2	-6.0	11.4	-25.1	59.2
TOTAL	-16.2	78.3	-10.8	9.8	-17.2	40.0	105.4	56.8	105.5	-13.2	25.1	-52.7	66.0
COMPETITIVENESS													
VALUE ADDED/EMPLOYEE	2.2	10.8	10.1	19.9	23.7	-13.0	32.2	-3.2	5.5	36.2	15.5		
EXPORTS	67.6	-9.8	-9.2	-36.2	20.9	14.7	41.5	53.9	54.0	3.5	-1.9	-28.4	
IMPORTS	19.5	27.5	-0.4	43.9	-39.3	18.4	80.5	35.8	74.9	11.6	-49.2	-13.3	

SOURCE: Calculated from Table 02 by Economics Practice, Currie, Coopers & Lybrand. Calculations based on unrounded data where available.

TABLE D4

AIRCRAFT AND AIRCRAFT PARTS MANUFACTURING (SIC 321)
ONTARIO
1971 - 1984
Constant 1971 Dollars

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	36	37	35	34	36	38	37	43	51	54	49	51		
CAPACITY UTILIZATION RATE, CANADA	70.9	76.9	91.7	89.2	84.0	88.0	90.7	88.6	88.2	66.6	61.1	52.0	58.8	
OUTPUT ($ Million)														
MANUFACTURING SHIPMENTS	253.0	243.4	243.2	214.4	174.4	182.5	161.0	237.1	276.0	324.0	362.6	289.3		
MANUFACTURING VALUE ADDED	148.6	142.4	147.7	141.3	115.5	107.1	97.8	142.2	155.3	196.5	200.3	383.3		
WAGES & SALARIES	101.5	105.5	108.4	98.7	81.0	73.6	77.4	105.9	121.7	163.6	151.7	130.1		
EMPLOYMENT (Number)														
PRODUCTION WORKERS	6,986	7,225	7,617	7,305	5,679	4,961	5,833	7,523	8,749	11,960	10,514	7,869		
ADMINISTRATIVE STAFF	4,105	3,995	4,176	4,060	3,216	3,018	2,640	3,720	3,895	5,083	5,286	4,863		
TOTAL	11,091	11,220	11,793	11,365	8,895	7,979	8,473	11,243	12,644	17,043	15,800	12,732		
CAPITAL INVESTMENT CANADA ($ Million)														
CONSTRUCTION	3.6	2.1	3.9	0.9	1.9	1.5	2.9	6.9	7.7	20.3	13.8	18.9	1.8	4.2
MACHINERY & EQUIPMENT	6.3	5.9	9.6	9.9	8.4	6.5	7.4	12.3	19.8	30.5	25.7	26.5	19.3	29.1
TOTAL	9.9	8.0	13.5	10.8	10.3	8.0	10.3	19.2	27.5	50.8	39.5	45.4	21.1	33.3
COMPETITIVENESS														
VALUE ADDED/EMPLOYEE (Dollars)	13,397	12,687	12,527	12,431	12,985	13,425	11,548	12,645	12,286	11,528	12,676	30,103		

NOTE: Calculations based on unrounded data where available. Shipments data deflated by the total Industry Selling Price Index as SIC 321 is not available and Transportation Equipment is secured to meet secrecy requirements of the Statistics Act; Value Added deflated by the Implicit Price Index for Gross Domestic Product for SIC 321; Wages and Salaries deflated by the Implicit Price Index for Personal Expenditure on Consumer Goods and Services; and Capital Investment deflated by the Implicit Price Indexes for Business Non-Residential Construction and Machinery and Equipment

SOURCE: Publications as outlined in Table D2. Also Statistics Canada, INDUSTRY PRICE INDEXES, Cat. No. 62-011; GROSS DOMESTIC PRODUCT BY INDUSTRY, Cat. No. 61-005; and NATIONAL INCOME AND EXPENDITURE ACCOUNTS, Cat. No. 13-201. Calculations and forecast deflators by Economics Practice, Currie, Coopers & Lybrand.

TABLE D5

AIRCRAFT AND AIRCRAFT PARTS MANUFACTURING (SIC 321)
ONTARIO
1971 - 1984
PER CENT CHANGE
Constant 1971 Dollars

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ESTABLISHMENTS (Number)	2.8	-5.4	-2.9	5.9	5.6	-2.6	16.2	18.6	5.9	-9.3	4.1		
OUTPUT ($ Million)													
MANUFACTURING SHIPMENTS	-3.8	-0.1	-11.8	-18.6	4.6	-11.8	47.2	16.4	17.4	11.9	-20.2		
MANUFACTURING VALUE ADDED	-4.2	3.8	-4.4	-18.2	-7.3	-8.7	45.3	9.3	26.5	1.9	91.4		
WAGES & SALARIES	3.9	2.7	-8.9	-18.0	-9.1	5.2	36.9	14.9	34.4	-7.3	-14.2		
EMPLOYMENT (Number)													
PRODUCTION WORKERS	3.4	5.4	-4.1	-22.3	-12.6	17.6	29.0	16.3	36.7	-12.1	-25.2		
ADMINISTRATIVE STAFF	-2.7	4.5	-2.8	-20.8	-6.2	-12.5	40.9	4.7	30.5	4.0	-8.0		
TOTAL	1.2	5.1	-3.6	-21.7	-10.3	6.2	32.7	12.5	34.8	-7.3	-19.4		
CAPITAL INVESTMENT, CANADA ($ Million)													
CONSTRUCTION	-41.7	85.7	-76.9	111.1	-21.1	93.3	137.9	11.6	163.6	-32.0	37.0	-90.5	133.3
MACHINERY & EQUIPMENT	-6.3	62.7	3.1	-15.2	-22.6	13.8	66.2	61.0	54.0	-15.7	3.1	-27.2	50.8
TOTAL	-19.2	68.8	-20.0	-4.6	-22.3	28.8	86.4	43.2	84.7	-22.2	14.9	-53.5	57.8
COMPETITIVENESS													
VALUE ADDED/EMPLOYEE	-5.3	-1.3	-0.8	4.5	3.4	-14.0	9.5	-2.8	-6.2	10.0	137.5		

SOURCE: Calculated from Table D4 by Economics Practice, Currie, Coopers & Lybrand. Calculations based on unrounded data where available.

TABLE D.6

OCCUPATIONAL INDICATORS: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

RANKING BY RELATIVE STRENGTH

		NUMBER OF EMPLOYEES 1981	AVERAGE ANNUAL RATE OF CHANGE PERCENT 1971 - 1981
I	TOTAL INDUSTRY	15,305	2.7
II	TWO DIGIT LEVEL		
	MACHINING AND RELATED	2,380	0.5
	MATERIAL HANDILING AND RELATED	180	1.8
	NATURAL SCIENCES, ENGINEERING AND MATHEMATICS	1,865	2.8
	PRODUCT FABRICATING, ASSEMBLING AND REPAIRING	6,310	4.1
	MANAGERIAL, ADMINISTRATIVE AND RELATED	785	5.3
	PROCESSING	410	12.2
III	FOUR DIGIT LEVEL		
	MACHINING AND RELATED		
	Tool- and Die-Making	215	(7.4)
	Machine-Tool Operating	250	(7.0)
	Welding and Flame Cutting	140	(1.0)
	Filing, Grinding, Buffing, Cleaning and Polishing, n.e.c.	160	1.7
	Metalworking-Machine Operators, n.e.c.	100	2.3
	Foremen, Metal Machining	115	3.1
	Sheet-Metal Workers	395	3.9
	Machinist and Machine-Tool Setting-Up	765	6.6
	TOTAL	2,380	0.5
	NATURAL SCIENCES, ENGINEERING AND MATHEMATICS		
	Mechanical Engineers	100	(6.7)
	Industrial Engineers	240	(2.2)
	Draughtsmen	145	3.3
	Architectural and Engineering, Technologists and Technicians	350	5.8
	Aerospace Engineers	565	6.7

TABLE D.6 (cont'd)

OCCUPATIONAL INDICATORS: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

RANKING BY RELATIVE STRENGTH

	NUMBER OF EMPLOYEES 1981	AVERAGE ANNUAL RATE OF CHANGE PERCENT 1971 - 1981
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS (cont'd)		
Systems Analysts, Computer Programmers and Related	200	8.3
TOTAL	1,865	2.8
PRODUCT FABRICATING, ASSEMBLING AND REPAIRING		
Foremen: Mechanics and Repairmen, n.e.c.	120	(0.4)
Inspecting and Testing, Fabricating and Assembling, Metal Products, n.e.c.	705	2.5
Aircraft Fabricating and Assembling, n.e.c.	3,045	3.3
Aircraft Mechanics and Repairmen	765	7.0
Foremen, Fabricating and Assembling, Metal Products, n.e.c.	595	8.0
Painting and Decorating, Except Construction	155	9.1
Electrical and Related Equipment Installing and Repairing, n.e.c.	340	14.2
TOTAL	6,310	4.1
MANAGERIAL, ADMINISTRATIVE AND RELATED		
Purchasing Officers and Buyers, Except Wholesale and Retail Trade	110	(0.4)
Accountants, Auditors and Other Financial Officers	130	5.7
TOTAL	785	5.3
PROCESSING		
Metal Processing and Related, n.e.c.	225	36.5
TOTAL	410	12.2

() Indicates decline

NOTE: Details do not add to totals as all occupations are not included.

SOURCE: Census data, Ontario Ministry of Labour.

TABLE D.7

OCCUPATIONAL INDICATORS: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

RANKING BY INCREASE IN FEMALE REPRESENTATION

		FEMALES EMPLOYED 1981	FEMALE EMPLOYMENT AS A PERCENT OF TOTAL 1971	1981	NUMBER OF JOBS GAINED BY FEMALES 1971-1981
I.	TOTAL INDUSTRY	2,020	10.0	13.2	845
II.	TWO DIGIT LEVEL				
	MATERIAL HANDLING AND RELATED	15	16.7	8.3	(10)
	PROCESSING	40	3.8	9.8	35
	NATURAL SCIENCES, ENGINEERING AND MATHEMATICS	80	2.5	4.3	45
	MANAGERIAL, ADMINISTRATIVE AND RELATED	100	5.3	12.7	75
	MACHINING AND RELATED	170	1.8	7.1	130
	PRODUCT FABRICATING, ASSEMBLING AND REPAIRING	390	4.0	6.2	220
III.	FOUR DIGIT LEVEL				
	PROCESSING				
	Metal Processing and Related	35	0.0	15.6	35
	TOTAL	40	3.8	9.8	35
	NATURAL SCIENCES, ENGINEERING AND MATHEMATICS				
	Draughtsmen	0	4.8	0.0	(5)
	Mechanical Engineers	0	0.0	0.0	0
	Industrial Engineers	5	0.0	2.1	5
	Architectural and Engineering Technologists and Technicians	15	2.5	4.3	10
	Aerospace Engineers	20	0.0	3.5	20
	Systems Analysts, Computer Programmers and Related	35	16.7	17.5	20
	TOTAL	80	2.5	4.3	45

TABLE D.7 (cont'd)

OCCUPATIONAL INDICATORS: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

RANKING BY INCREASE IN FEMALE REPRESENTATION

	FEMALES EMPLOYED 1981	FEMALE EMPLOYMENT AS A PERCENT OF TOTAL 1971	1981	NUMBER OF JOBS GAINED BY FEMALES 1971-1981
MANAGERIAL, ADMINISTRATIVE AND RELATED				
Accountants, Auditors and Other Financial Officers	15	6.7	11.5	10
Purchasing Officers and Buyers, Except Wholesale and Retail Trade	30	0.0	27.3	30
TOTAL	100	5.3	12.7	75
MACHINING AND RELATED				
Tool- and Die-Making	0	0.0	0.0	0
Sheet-Metal Workers	5	1.9	1.3	0
Welding and Flame Cutting	20	12.9	14.3	0
Machine-Tool Operating	10	0.0	4.0	10
Metalworking-Machine Operators, n.e.c.	10	0.0	10.0	10
Foremen, Metal Machining	15	0.0	13.0	15
Filing, Grinding, Buffing, Cleaning and Polishing	25	3.7	15.6	20
Machinist and Machine-Tool Setting-Up	65	1.2	8.5	60
TOTAL	170	1.8	7.1	130
PRODUCT FABRICATING, ASSEMBLING AND REPAIRING				
Foremen, Fabricating and Assembling, Metal Products, n.e.c.	0	0.0	0.0	0
Foremen: Mechanics and Repairmen, n.e.c.	5	0.0	4.2	5
Aircraft Mechanics and Repairmen	10	1.3	1.3	5
Painting and Decorating, Except Construction	10	0.0	6.5	10

TABLE D.7 (cont'd)

OCCUPATIONAL INDICATORS: AIRCRAFT AND AIRCRAFT PARTS MANUFACTURERS

RANKING BY INCREASE IN FEMALE REPRESENTATION

	FEMALES EMPLOYED 1981	FEMALE EMPLOYMENT AS A PERCENT OF TOTAL 1971	1981	NUMBER OF JOBS GAINED BY FEMALES 1971-1981
PRODUCT FABRICATING, ASSEMBLING AND REPAIRING (cont'd)				
Inspecting and Testing, Fabricating and Assembling Metal Products, n.e.c.	50	4.5	7.1	25
Electrical and Related Equipment Installing and Repairing, n.e.c.	65	27.8	19.1	40
Aircraft Fabricating and Assembling, n.e.c.	145	3.8	4.8	60
TOTAL	390	4.0	6.2	220

() Indicates decline.

NOTE: Females employed in 1981 is calculated from percent of total.
Details do not add to totals as all occupations are not included.

SOURCE: Census data, Ontario Ministry of Labour.

FINAL REPORT AND APPENDICES OF THE ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

Final Report — Employment and New Technology

Appendices:

1. Labour Market Trends in Ontario, 1950-1980
2. Occupational Employment Trends in Ontario, 1971-1981
3. Emerging New Technology, 1985-95: Framework for a Survey of Firms
4. Employment and New Technology in Ontario's Manufacturing Sector: A Summary of Selected Industries
5. Employment and New Technology in the Iron and Steel Industry
6. Employment and New Technology in the Metal Fabricating Industry
7. Employment and New Technology in the Machinery and Equipment Industry
8. Employment and New Technology in the Aircraft and Aircraft Parts Industry
9. Employment and New Technology in the Communications Equipment Industry
10. Employment and New Technology in the Office, Store and Business Machine Industry
11. Employment and New Technology in the Plastic Processing Industry
12. Employment and New Technology in Ontario's Service Sector: A Summary of Selected Industries
13. Employment and New Technology in the Chartered Banks and Trust Industry
14. Employment and New Technology in the Insurance Industry
15. Employment and New Technology in the Government Services Industry
16. Employment and New Technology in the Telecommunications Industry
17. Employment and New Technology in the Retail Trade Industry
18. Employment and New Technology in the Computer Services and Management Consulting Industry
19. Industry-Sector and Occupational Employment in Ontario, 1985-1995
20. Technological Change, Productivity, and Employment: Studies of the Overall Economy